DESIGN AND DEVELOPMENT OF AN IOT BASED NIGHT PATROLLING ROBOT

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.

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APPROVAL

This Project/internship titled **"DESIGN AND DEVELOPMENT OF AN IOT BASED NIGHT PATROLLING ROBOT"**, submitted by Mohaimenul Islam, ID No: 183-15-11831 and Bulbul Rahman, ID No: 183-15-11859 and Sajeeb Saha, ID No: 183-15-11792 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 12/09/2022.

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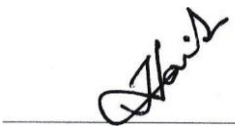

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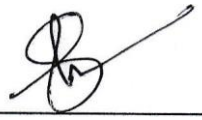

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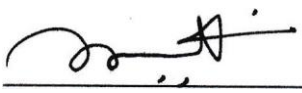

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We hereby declare that, this project has been done by us under the supervision of **Mr. Abdus Sattar, Assistant Professor, CSE Department**, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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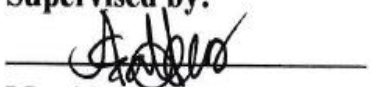

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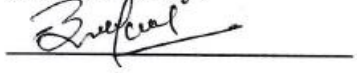

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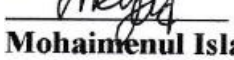

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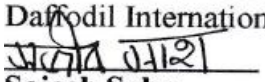

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ABSTRACT

In today's world, technology is crucial in many organizations. Nowadays, almost everyone has access to the internet, so no one can deny the value of technology. There are numerous websites that have been discovered to provide a variety of online services. Because the world is evolving with technology, it is necessary to use technology whenever possible. Through technology, a night patrolling robot can solve the problem of night security. In light of these considerations, we attempted to create a night patrolling security robot. We designed and developed a night patrolling robot system that will aid in the resolution of security issues in our society. The main goal is to improve security in our homes, offices, and factories. The night patrolling robot is a security guard who will keep us safe. The night patrolling robot will issue whenever someone enters through the gate. We used the V-model as the methodology to develop our project because it is a type SDLC model in which processes are executed sequentially in a v shape. It is also referred to as the verification and validation model. It is a highly disciplined model, with phases completed one by one. It is very simple to understand and apply. Because of the model's rigidity, it is simple to manage. Security Robot operates at the crossroads of night patrolling and crime. Its goal is to use modern information technology to ensure security and law enforcement. In the current state of Bangladesh, this project is critical for security robot activities in our country. The monitoring system for our proposed security robot vehicle is dependable, simple to implement, and user friendly. It continues to monitor the construction site. This project can be used in the home, office, and a variety of other settings. This project can benefit the owners of a house, an office, and many other properties.

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INTRODUCTION

1.1 Introduction

With a growing trend of social aging and accelerated pace of life, it becomes increasingly common for children and the elderly to live in different cities and the issue of "empty-nest" elderly becomes increasingly serious. In order to ensure security of the elderly, it needs to implement real-time monitor to the home security. Robot technology is one of great significance to develop a home security night patrol robot integrating monitoring, alarming, education, entertainment, and even assistance and home care of the elderly to improve the living quality and materialize the concept of the smart city.

Robotic technologies are now being employed to help people perform certain activities in hazardous areas as efficiently as possible. In order to assist with a special work involving building monitoring and security, we suggest offering a robotic solution. This device takes the place of security officers on the ground. The system uses autonomous robots that can patrol, monitor, and maintain the security of an area. The project prototype will be known as the Autonomous Security Patrol System due to its functionality.

The security patrol robot will use a variety of sensors and motors to autonomously explore within buildings. Additionally, it will be able to communicate and be controlled via an SMS alert GSM module.

This system has several sensors built on Arduino that enable it to seek assistance if it encounters any unidentified items or individuals and alert us via a buzzer and SMS to the user's mobile device.

Robotic security guards who prowl the night will watch over us. The night patrolling robot will sound alarms if someone passes past the gate

1.2 Motivation

The night patrolling robot system is more than effective and equitable from other projects. This system also improves effectiveness, efficiency, and security. Our proposal also aimed to contribute to the creation of a new, standard, and improved manual security guard or watchman. This project will save money and enhance security.

1.3 Rationale OF The Study

Night patrolling robot system is more than effective, timely and equitable from others project. This system also improves effectiveness, efficiency and security. Our project also hoped that the research would aid in the development of a new and hopefully better manual security guard or watchman. This project will save money and enhance security.

1.4 Expected Output

- To design and implementation of an IOT Based Night Patrolling Robot.
- To provide enhanced security in house hold or office or Industrial areas.

1.5 Report Layout

Chapter 2, here we discussed about the background of our project. We also added information about other related works and compared those works with ours. We also mentioned about some of the challenges that we have faced.

Chapter 3, we discussed about methodology and implementation requirements.

Chapter 4, we present cost analysis, experimental setup as well as experiment result of our project. Result analysis was also added.

Chapter 5, we discussed about impact on society, environment and sustainability of our project.

Chapter 6, discussed about conclusion, scope for further development and study as well as our limitations of this project.

CHAPTER 2
BACKGROUND

2.1 Preliminaries/Terminologies

In this project the main objective is a night patrolling robot using Arduino application for night security guard. This project plays vital roles in our country for security robot activities. It is a microcontroller-based control system where use a laser for detects any limited line. And the robot follows a line for patrolling the coverage area.

In this work the design of a robot is presented which will move around in our limited area. The night patrolling robot presented in this project will combine several of this technology to have autonomous and android application capability. It will maintain line flowing technique and produce primary alarm system. In this system should be operating in an indoor setting with GSM module for SMS alert.

2.2 Related Work, Comparative Analysis and Summary

Hou-Tsan Lee et al., designed a night patrolling robot using microcontroller.[3] The main theme was the used the automatic power supply by Solar. It is very large and need a big amount of cost. The robot controlled using the mobile apps. It used night vision camera, sensor, a speaker, and the 4 big size of while. This robot can capture a picture and send it by SIM. In this project, Open CV technology is used for face detection. If a warning message is detected, the user can direct the self-propelled vehicle via smartphone remote control. The difference from this project our project is simple and small. Another difference is don't need more cost for this project. So, its low-cost project.

Jonathan Garcia et al., has introduces a night patrolling security Autonomous Robot which was being designed using Arduino.[4] This security patrol robot will use a variety of sensors and motors to navigate indoors autonomously. Wi-Fi will also be used for communication and control. The two main treads are rotated by the robot's two DC motors on either side. The servo motor controls the flipper arm mechanism. Located in the center of the robot. This includes the ability to climb stairwells, curbs, and steeper slopes. The

main difference between this project and others is that we communicate via SIM card and do not use the climbing option. We do not use Wi-Fi control in our project; instead, we use manual communication.

TahzibMashrik et al. created a security patrolling robot.[8] Indoor autonomous mode and navigation mode are employed. Wi-Fi will also be used for communication and control. The system modeling is covered in the section on system design. The SPA employs a variety of sensors to detect security threats. The passive infrared motion sensor, light sensor, temperature sensor, sound sensor, and ultrasonic sensor are all examples of applications for this material. All of the sensors are linked to the Arduino. An object avoidance sensor was used. We'll add a buzzer that emits a special whistle after a certain amount of time, and we'll also use a GSM module to send an SMS message to a SIM card.

K BhavyaSriet al., presented a border security robot system that employs a variety of equipment.[7] This actually lays the groundwork for border patrolling for security. There is an Arduino, a wheel, and many other parts used. They also use an LED display to display the messages. They also use an ultrasonic sensor, a metal detector, and a fire extinguisher. We will not use an LED display or a Fire Sensor.

Chandramohan et al. created a patrol robot with a Wi-Fi module.[1] They used an Arduino nano and a Wi-Fi Module to remotely control a home appliance. It can be controlled without internet by using voice commands. The robot is outfitted with a voice recognition system. There is a distinction between voice recognition and speech recognition. It is dependent on the type of recognition module and algorithm used by the robot to recognize a user's voice. The robot can only recognize voices and cannot distinguish between users. Out patrolling robots are controlled automatically and do not require any voice commands. Our patrolling robot simply flowed a line to patrol the home area.

CH. Tejasris., build a women safety night patrolling robot for the women in India.[2] It’s a microcontroller (LPC2148) base robot and added some featured. This project used a power supply, push on switch, vibration sensors, WIFI module (ESP8266 WIFI), have

LCD display and GPS tracking system for location. LCD display for the current situation of this area and GPS tracking system used for the location tracking. Now our project won't use the LED display and not use GPS tracking system for the location tracking.

M.Tanas at al., build autonomous robotic patrol vehicle.[6] The main disadvantage of this project is inflexibility. I think this robot is not able to patrol in night cause have not included any night vision patrolling camera. Another reason robot will not able to patrol in bad weather. Another disadvantage this robot may be risky for the known member. The advantage of this robot mobility. Hopefully this may helpful for the controlling with the mobile. They use this patrolling robot with voice command and using safety sensor and driving sensor at day/night. Out project will be flexible and user friendly.

Takato Saito et al. created a Mobile Robot with GPS and a location recognition system. The project proposes a survey of a mobile robot using GPS data.[9] It is important to consider GPS technology when tracking the robot. We face some critical issues in this, such as obtaining high accuracy, stability, and the need to improve a few restrictions that GPS observations impose. Face issues such as multiple paths and signal loss, particularly in congested areas and outside of coverage areas. This method is used with positional errors disabled by GPS. In our night patrolling robot, we do not use a face recognition system. And in this project, the signal may not be lost.

Kirk MacTavishe and colleagues developed night rider visual odometry using headlights.[5] For mobile robotic systems, this technology estimates relative motion using a sequence of camera images. Cameras can be used to collect large amounts of data and are relatively inexpensive sensors, making them ideal for use in moveable robots. However, because it is a passive component, it will rely on an external power supply, which may limit its availability. Many other sources are available for lightning purposes, such as. For power, we use a battery in our robot.

W.S MadaSanjaya et al., have introduced face recognition and tracking for human robot interaction using a personal computer with Arduino board.[11] Another extension is an 8

MP (mega pixel) web camera a social robot syPEHUL. Webcam worked as a social robot vision sensor for detect face. After detect the face computer will store every face in memory. Now we use a build in camera and no needed any external memory. In our project we are not use any wed camera.

Umeraanjum et al. created a project called Theft Detection with Raspberry Pi.[10] For embedded and real-time applications, they used the Linux operating system. This project is small and requires little power. They are beneficial in terms of providing efficient performance in embedded applications. Have an IR sensor detect motion and send the signal to a Raspberry Pi to capture camera footage. The system uses image processing to detect an exact area of motion occurrence and highlights it. UVC (Universal Video Class) Camera was used in another extension. Although our project is small and requires little power, we do not use a mobile application to control our system.

2.3 Scope of the Problem

The security robot works at the crossroads of night patrolling and crime. A fully autonomous data security machine is what it is called. Its purpose is to supplement security and law enforcement with modern information technology tools.

In the current state of Bangladesh, this project is critical for security robot activities in our country. Our proposed security robot vehicle activity monitoring system is dependable, simple to implement, and easy to use. It continues to monitor the construction site. This project is beneficial to the home, office, and many other sectors. This project can benefit the owners of a house, an office, and many other properties.

This type of security has many applications in real life. It can be used in a variety of industries when producing goods.

2.4 Challenges

Throughout developing any project we have to face various kinds of challenges that we need to overcome. Before developing our project we need to keep in mind that what purpose our project serves. We need to ensure proper security. We also need to keep in mind about the environment where we are working along with our project. Our project's environment can vary from place to place. So, we need to ensure that our project can run smoothly in every environment.

CHAPTER 3

METHODOLOGY

3.1 Methodology

V-Model is also known as the Verification and Validation Model. This requires that each stage of the SDLC be finished before moving on to the next. The waterfall model's sequential design approach is also followed. The device's testing is scheduled concurrently with the relevant stage of development.

3.2 Justification of Methodology

The project is principally focus on Night guard patrolling robot and automatically control by follow a line. Mainly two part of this project the hardware (robot car) and the software. This approach is very straightforward and incredibly simple to utilize. Since our requirements are definite and clearly stated, we selected the v model as our methodology. V model is very time-efficient. Hence, the waterfall model has a lower chance of success.

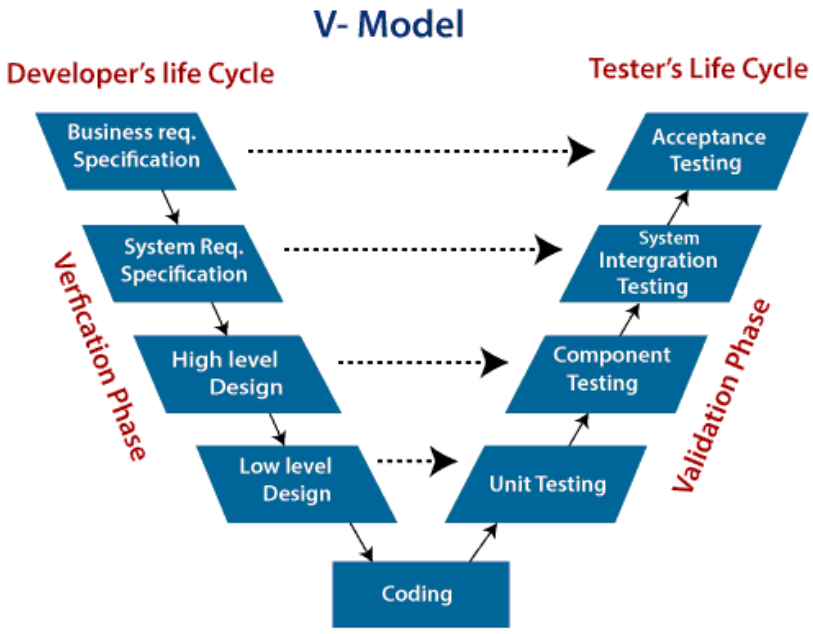

Figure 3.1: V-Model

3.3 Description of Methodology

Verification: Verification entails a static analysis technique (review) carried out without actually running any code. To determine whether specific requirements are met, the product development process is evaluated.

Validation: Testing is done by running code, and validation comprises dynamic analysis methods (functional and non-functional). After the development phase is complete, the software is categorized throughout the validation step to see if it satisfies the needs and expectations of the client.

Therefore, the V-Model has Validation stages on one side and Verification phases on the other. Coding phase joins the verification and validation processes in a V-shape. As a result, it is known as V-Model.

There are several stages in the V-Verification model's Phase:

Business requirement analysis: It is the initial step in understanding product requirements from the perspective of the client. To fully comprehend the expectations and precise needs of the consumer, this phase involves comprehensive discussion.

System Design: System engineers utilize the user requirements document to examine and comprehend the proposed system's business.

Architecture Design: The first step in choosing an architecture is to have a basic understanding of everything that will be included, such as the list of modules, a brief description of each module's functionality, the relationships between the modules' interfaces, any dependencies, database tables, architecture diagrams, technology details, etc. A certain step includes the integration testing model.

Module Design: The system is divided into manageable modules at the module design stage. Low-Level Design, which is the specification of the modules' intricate design

Coding Stage: The coding step begins after designing. It is decided on a programming language that will work best based on the criteria. For coding, there are some rules and standards. The final build is enhanced for greater performance prior to checking it into the repository, and the code undergoes numerous code reviews to verify its performance.

There are several stages in the V-validation model's phase:

Unit Testing: The V-module Model's design phase is when Unit Test Plans (UTPs) are created. To get rid of problems at the unit or code level, these UTPs are run. The smallest thing that can exist on its own is a unit, like a program module. Unit testing ensures that even the tiniest component can operate properly when separated from other scripts or units.

Integration Testing: Plans for testing for integration are created at the architectural design phase. These tests demonstrate that separate groups can coexist and communicate with one another.

System Testing: During the system design phase, plans for system testing are created. System test plans, in contrast to unit and integration test plans, are created by the client's business team. System testing makes sure that an application developer's requirements are met.

Acceptance Testing: The examination of business requirements is related to acceptance testing. The software product is tested in a user environment. Acceptance tests highlight any system compatibility issues that may exist within the user environment. Additionally, it identifies non-functional issues like load and performance flaws in the context of actual user interaction.

3.4 Implementation Requirements

3.4.1 Requirement Analysis

A project's requirement analysis is a crucial component. The success or failure of a project is dependent on the results of the requirements analysis. The prerequisite must be registered for, documented, chargeable, measurable, tested, traceable, and tied to an established need or circumstance. We need to find out the important element for the project in this part following they steps. They are requirement elicitation and requirement specification.

3.4.1.1 Requirement Elicitation

Requirements elicitations are the method of exploration and invention the requirements of a system from users. It is also sometimes notice to as requirement gathering. in this robotics project we have reviewed some subsist systems related to our project for requirement elicitation.

3.4.1.1.1 Legacy System Review

Takato Saito developed a mobile robot using a place-recognition system and GPS. A survey of a moving robot with GPS observations is suggested by the project. It is significant in light of robot tracking via GPS technology. We must address some crucial problems in order to achieve high accuracy, stability, and to improve a few limitations placed on GPS observations. Face issues like multiple paths and signal loss, especially when in a crowded place or an unreachable area. This technique uses GPS location data to eliminate inaccuracies.

We have decided to use Arduino IDE for the software requirement and for the hardware requirement we will use Arduino ATmega along with motors and wheels for better performance. We are not going to use any camera for image recognition. We will use a serial communication via Bluetooth using a hardware called Bluetooth module.

Hou-Tsan Lee designed a night patrolling robot using microcontroller. The main theme was the used the automatic power supply by Solar. It is very large and need a big amount of cost. The robot controlled using the mobile apps. It used night vision camera, sensor, a speaker, and the 4 big size of while. This robot can capture a picture and send it by SIM. In this project, Open CV technology is used for face detection. If a warning sign is seen, the user can remotely manage the self-propelled vehicle using a smartphone.

The difference from this project our project is simple and small. Another difference is don't need more cost for this project. So, its low-cost project. We build our night patrolling robot using an Arduino NANO and the main power supply by 4800mAh 3.7V li-ion Battery. No need any control. If is detect any object it will give a message.

3.4.2 Requirement Specification

All possible requirements of the system to be developed are captured in this phase and documented in a requirement specification. We have analyzed the following requirements.

3.4.3 Hardware Requirements

In table-1, we have listed the all hardware items, which are shown in below.

Table-1.1: List of Hardwires

SL NO	Item	Quantity	Used
1.	Arduino nano (ATmega328)	1	To control the system
2.	Smart car mounted holder	1	For object detection.
3.	18650 Battery holder/case 4 Chamber	1	For attach Battery
4.	Buzzer module	1	Used for Alarm system
5.	Battery 3000MAH Rechargeable li-ion 18650 3.7v	4	For Power
6.	SIM 800 L	1	For SMS system
7.	Dc buck LM2596 DC-DC buck converter step down module	2	Convert step down module
8.	Female-female jumper ware	10	For connection
9.	DPDT centre off PCB mount miniature slide switch	1	For on/off the robot
10.	Breadboard/ project board	1	Test symbol circuit
11.	L298N stepper motor driver	1	For control DC motor
12.	HC-SR04 Distance sensor ultrasonic	1	Ultrasonic sound.
13.	IR sensor module	2	For LED transmission
14.	Robotic Chassis four while	1	For run the robot

3.4.3.1 Arduino Nano (ATmega328)

A microcontroller board based on the ATmega 328 is the Arduino mini. The 32 KB of the ATmega328 include 2 KB for the boot loader. Two KB of SRAM and one KB of EEPROM make up the ATmega328.

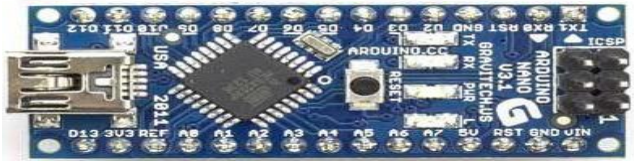

Figure 3.2: Arduino Nano

The Mini-B USB port, a 6-20V unregulated external power supply (pin 30), or a 5V regulated external power supply are all options for powering the Arduino Nano (pin 27). The greatest voltage source is automatically chosen as the power supply.

3.4.3.2 Smart car mounted holder

- Thickness: 2.8~3.1mm
- Inside dimension: 16mm
- Fasten hole: 3.8mm
- Order content: 1 x Holder
- Used for HC-SR04 Ultrasonic Transducer

Feature 3.3: Mount Holder

3.4.3.3 Battery Holder

Power Bank with 18650 Battery Holder: A battery holder is a device with one or more chambers or compartments for holding batteries. The holder must also make electrical contact with the battery terminals when using dry cells. Cables are frequently attached to the battery terminals for wet cells, as is the case with emergency lighting equipment or autos. A tab welded to the battery terminals can be connected directly to a printed circuit board in cases when the battery is anticipated to endure the whole lifespan of the device.It has also

- Small and portable

- High-quality plastic holders,
- 1pcs 18650 Battery Holder Case.
- Uses four standard-size 80650 batteries stacked on top of each other to create a small battery with a 3.7V voltage.
- Batteries are not supplied.

Figure 3.4: Battery Case

3.4.3.4 Buzzer Module

A mechanical, electromechanical, or piezoelectric audio signaling device is a 5V Active Alarm Buzzer Module for Arduino. It is the same 5V DC Electronic Part Active Buzzer Module that you are seeing right now. It is made of high-quality materials and is robust in usage.

Figure 3.5: Buzzer Module

When the signal is strong, the Active Buzzer Arduino module makes a single-tone sound. The Passive Buzzer module can be used to generate various tones. An oscillator and a

piezoelectric buzzer make up the Active Buzzer module. When the signal is strong, it produces a sound at a frequency of about 2.5 kHz.

Features:

1) Drive with a S8550 PNP transistor.
2) Convenient program control.
2) PCB size: 2.0 x 2.0 cm; working voltage: 3.3 to 5V.
4) Equipped with a power light and a digital signal output indication.

3.4.3.5 Battery

Flat head 3.7v 3000MAH 18650 rechargeable lithium-ion battery.

• Blue 38000mAH 18650 3.7V Rechargeable Lithium Battery.
• A 3.7V 18650 3000mAH rechargeable lithium-ion battery.
• Up to 1000 recharge cycles with no memory effect.
• Japanese battery cells of the highest caliber.
• 100% Quality Control on each battery; produced by Hi-Capacity Power Products.

Figure 3.6: Li -ion Battery

3.4.3.6: GSM Module, SIM 800 L

The SIM800L is a tiny cellular module that supports GPRS transmission, SMS sending and receiving, and voice calls making and receiving. This module is the ideal choice for any project that needs long distance connectivity because of its low cost, compact size, support for four bands of frequencies, and low cost. The power module starts up after being connected, looks for a cellular network, and logs in automatically. LEDs on board show the connection state (no network coverage - fast blinking, logged in - slow blinking).

Figure 3.7: GSM Module

Specifications:

- Module size: 25 x 23 mm;
- Supply voltage: 3.8V-4.2V;
- Recommended supply voltage: 4V;
- Interface: UART (max. 2.8V) and AT instructions
- Supported frequencies: Quad Band (850/950/1800/1900 MHz);
- SIM card socket: micro SIM (bottom side);
- Antenna connector: IPX;
- Status signaling: LED

3.4.3.7 Dc buck LM2596 DC-DC buck converter step down module

Buck Converter, DC-DC a 3-A load can be driven by the step-down (buck) switching regulator in the Step down Module LM2596 Power Supply with excellent line and load regulation. These devices come with 3.3 V, 5 V, 12 V fixed output voltages as well as an adjustable output version. Because the LM2596 series switches at 150 kHz, fewer filter components are possible than with switching regulators that operate at lower frequencies.

Figure 3.8: DC-DC Buck Converter

Specifications:

- 92% conversion efficiency (highest)
- Output ripple is limited to 30 mA9 at a maximum switching frequency of 150 kHz.
- Load regulation: less than 0.5%
- Voltage Control: 0.5%
- 5% 200uS Dynamic Response time
- Output voltage: 1.22 to 26 volts; input voltage: 4.75 to 35 volts (Adjustable)
- Up to 92% conversion efficiency (output voltage higher, the higher the efficiency)
- 150KHz is the switching frequency.
- Non-isolated step-down module's properties (buck)
- Current limiting for short circuit protection, as the recovery
- Industrial grade operating temperature range (-40 to +85) (output power 10W or less)

3.4.3.8: Male-Female jumper ware

Convenient for constructing wire harnesses or hopping between PCB headers. These premium jumper wires are a strip of 40 and are roughly 6" (150mm) long (4 pieces of each of ten colors). They fit neatly next to one another on a standard-pitch 0.1" (2.54mm) header and feature 0.1" sockets on both ends. These were recently upgraded to replace the individual wires with a "ribbon strip." The ribbon wires can always be removed to create separate jumpers or kept together to create neatly arranged wire harnesses.

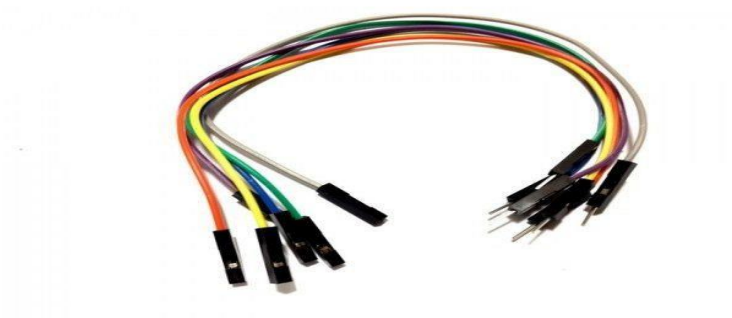

Figure 3.9: Wire

3.4.3.9: DPDT centre off PCB mount miniature Slide Switch

Slide switches are used to regulate the amount of current flowing through a circuit. Typically, a mechanical slider is utilized to slide between open and closed states to turn a current on and off. Slide switches are frequently employed as the principal power switch in tiny, battery-powered electrical devices because they are excellent at controlling current flow in smaller circuits.

Figure 3.10: Slide Switch

3.4.3.10: Breadboard / Project Board

You should definitely use this green Mini Breadboard to prototype your little ideas. They're fantastic for breaking down DIP package ICs to jumper wires, and there's just enough room for 170 tie points to design and test simple circuits. These miniature breadboards can be connected to create longer pieces of board if you run out of space. It contains two mounting holes for M2 screws and a peel-and-stick adhesive backing so you can secure it.

Figure 3.11: Breadboard/Project Board

3.4.3.11: L298N stepper motor driver

Normally used to operate DC motors, this driver board is also a cheap substitute for controlling stepper motors. Most stepper motors, like a NEMA 17, can have their speed and direction of rotation controlled. The STMicroelectronics L298 dual full-bridge driver is the foundation of the L298N Motor Driver Board. You can control DC motors, stepper motors, relays, and solenoids with this motor driver. It has two independent channels called A and B that can be used to operate two DC motors separately or one stepper motor when they are used together.

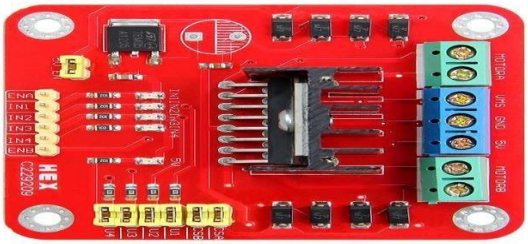

Figure 3.12: Stepper Motor Driver

3.4.3.12: HC-SR04 Distance Sensor Ultrasonic

The ultrasonic distance sensor in question is the HC-SR04. With a range accuracy that can reach up to 3mm, this affordable sensor offers non-contact measurement functionality from 2 cm to 400 cm. There is an ultrasonic transmitter and receiver in every HC-SR04 module.

Figure 3.13: Supersonic Transmitter

The HC-SR04 only has four pins that require attention: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). For your upcoming range-finding project, this sensor will be incredibly simple to set up and utilize.

Specification:

- Quiescent Current: 2mA;
- Working Current: 15mA;
- Effective Angle: 15°;
- Ranging Distance: 2cm - 400 cm/1″ - 13ft;
- Resolution: 0.3 cm;
- Measuring Angle: 30 degree
- Dimensions are 45mm x 20mm x 15mm, with a trigger input pulse width of 10uS.

3.4.3.13: IR Sensor Module

A variable resistor (trimmer pot), or simply output LED LED IR Transmitter. Infrared LEDs produce light in this frequency range. We cannot see infrared light because its wavelength (700 nm to 1 mm) is substantially higher than that of visible light.

Figure 3.14: IR Sensor

Features:

- 5VDC Operating voltage,
- I/O pins that are compliant with 5V and 3.3V,
- a range of up to 20 cm,
- and adjustable sensing range
- Ambient light sensor built-in,
- 20 mA supply current,
- mounting hole

Applications:

- Obstacle Detection
- Industrial safety devices
- Wheel encoder

3.4.3.14: Robotic Chassis four while

An easy to install and use robot chassis platform is the 4-Wheel Robot Chassis Kit. You have everything you need in the Chassis kit to provide your robot a quick, four-wheel drive platform with room to grow and add additional sensors and controls.

Features:

- Adopts four DC motors for higher power, speed, and load capacity
- Large and stable Chassis, simple for extension
- Simple mechanical structure, easy for installation
- Simple Arduino development platform interface
- Vast space between the center and bottom chassis
- This kit is excellent for robotics competitions, academic research, and DIY learning.

Figure 3.15: Robotics Chassis

Specifications:

- 3-6V DC for operating voltage
- Dimensions: 25.3 cm in length
- 14.8 cm in width
- 6.5 cm in tire diameter

3.4.4: Software Requirement

3.4.4.1: Arduino IDE

An actual programmable circuit board known as an Arduino (sometimes referred to as a microcontroller) is included, as well as software called an IDE (Integrated Development Environment) that runs a computer. utilized to upload and write computer code to the actual board. Only a set of C/C++ functions that can be called from the code make up the Arduino Language. Minor adjustments are made to the project sketch before it is sent directly to a C/C++ compiler.

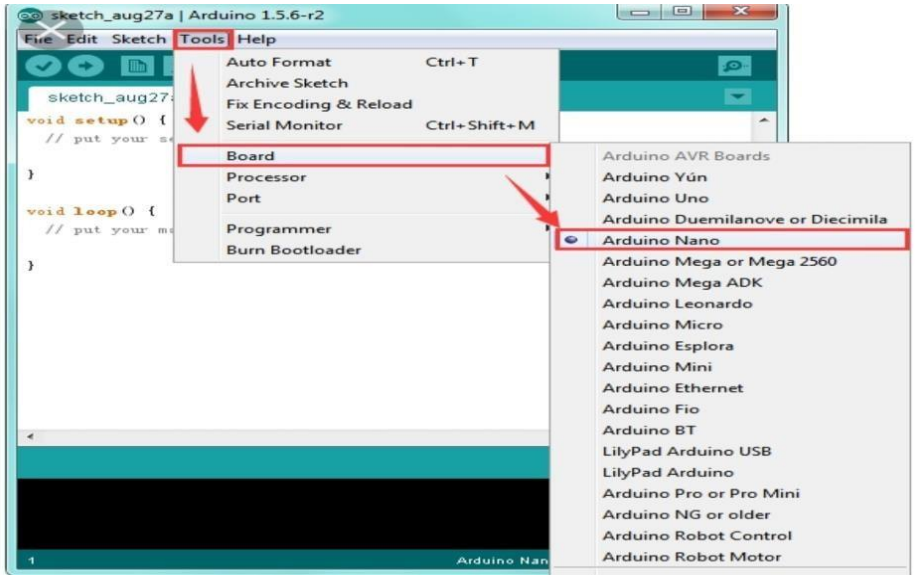

Figure 3.16: Arduino IDE Coding Interface

3.5: Dataset Utilized

It is important to ensure our system has good accuracy. In order to get that accuracy we needed to do test and trials for several times. Dataset consists of session details like total testing times, success rate and failure rates.

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1: Experimental Setup

4.1.1 Design & Development

The design and development part have some basic function. The functions are regarding as follows.

4.1.2 Block diagram of the proposed robot model

A block diagram is a system representation in which the main components or functions are represented by blocks connected by arrows that indicate the blocks' relationships. They are being utilized in engineering for process follow diagrams, electronic design, and software design.

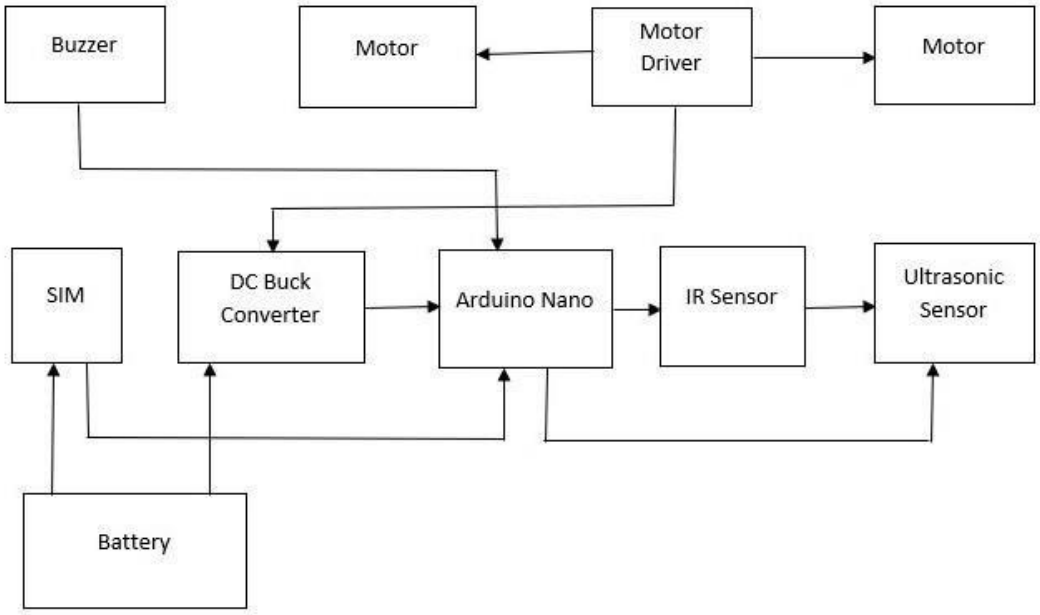

Figure 4.1: Block Diagram

Description of Block Diagram:

From this block diagram we can see that an Arduino Nano, motor shield, 4 motors, a Bluetooth, buzzer, IR Sensor, ultra-sonic sensor, Motor driver, battery and switch has been used. Here use 4 batteries for power supply, and used a SIM for the transfer data. Here we used 4 while for run or move another place. We used switch for robot on and off. Used a supersonic transmit for sound.

4.1.3 Circuit Diagram of the proposed robot model

An electrical circuit is represented graphically in a circuit design. While a schematic design uses standardized symbolic representations to show the components and connections of the circuit, a pictorial circuit diagram uses actual component configurations.

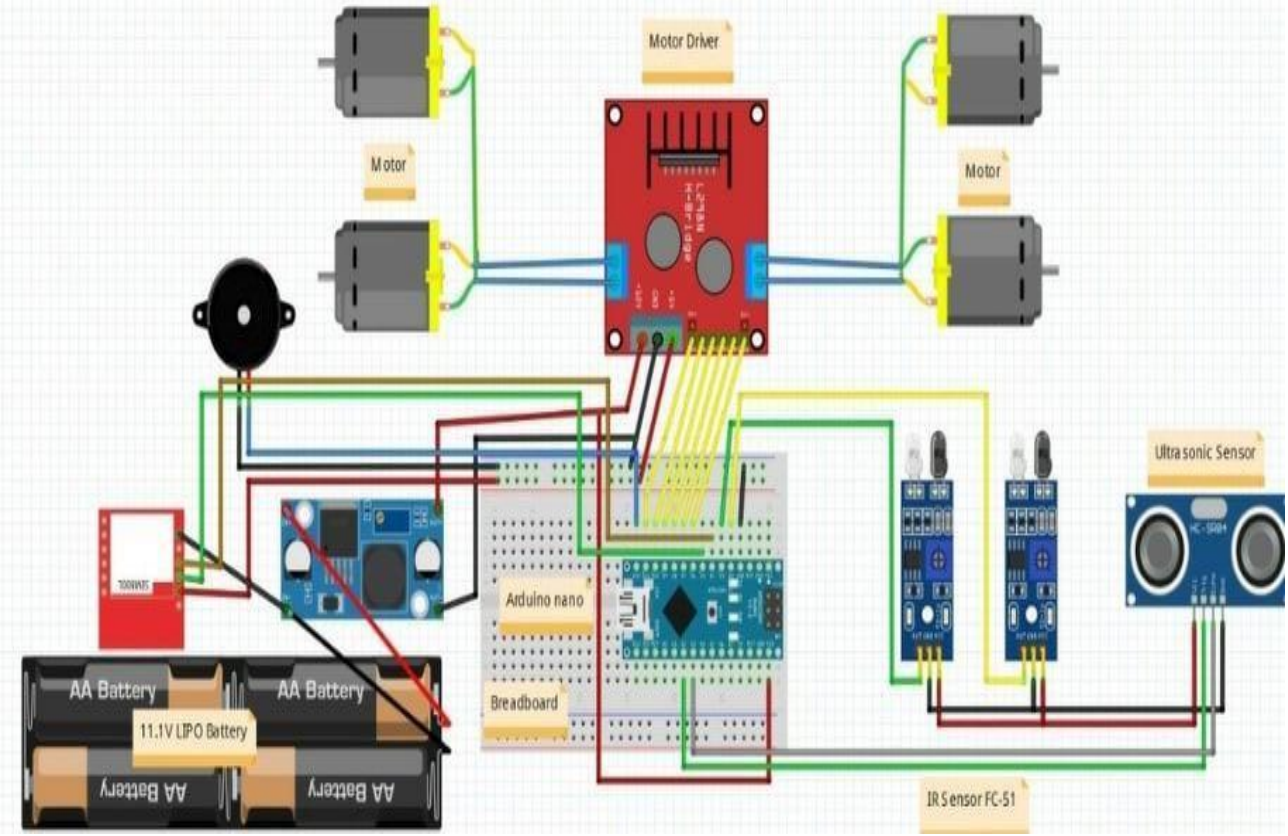

Figure 4.2: Circuit Diagram

4.1.4 Project Dataflow Diagram

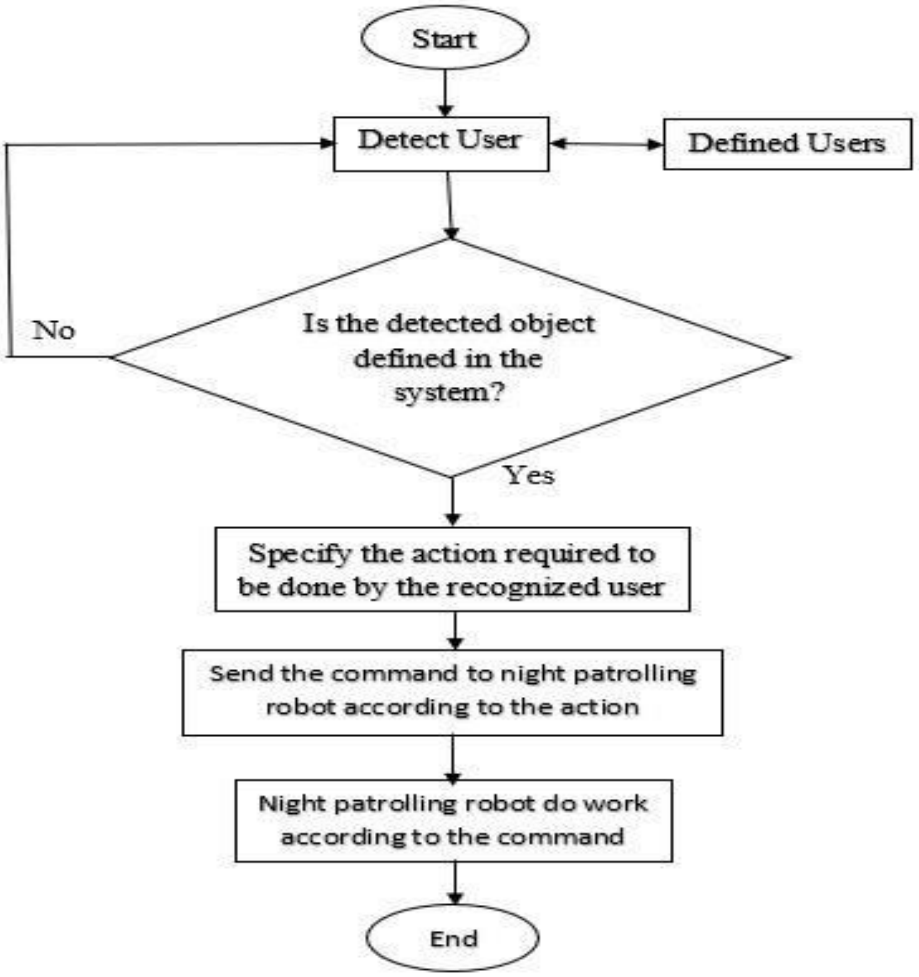

Figure 4.3: Dataflow Diagram

Description of Data Flow diagram:

First start a robot we gave some command to the robot. That command robot will run and detect the object that we gave. If robot can't detect any object robot certainly work with the command. Robot will follow the line that we select and give round in the selected area. It will go forward and follow the selected line until detect the object.

4.1.5 Project Workflow Diagram

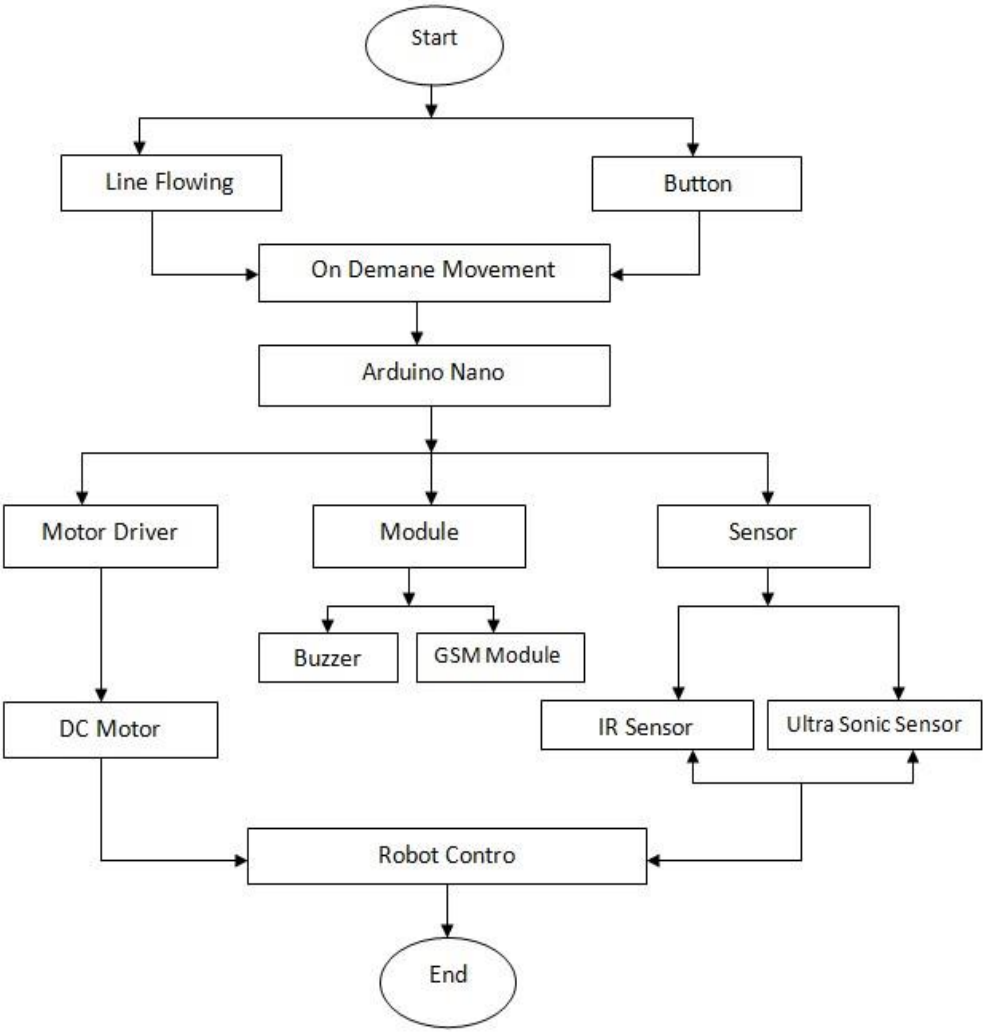

Figure 4.4: Project Workflow Diagram

Description Project Workflow diagram:

In workflow diagram we start a robot with a switch and robot follow the line. Those are connected with the Arduino nano for the operation. Arduino nano control the whole process that we give the command. Arduino connect with motor driver, module and sensor to give the feedback. Sensor connect with IR sensor and Ultra Sonic Sensor to detect the object. IR sensor do follow the line. Motor driver changes the position one from another place. We use GSM module to give sms after detecting an object. Buzzer gives us a period announce and aware to the object.

4.1.6 Pin Diagram

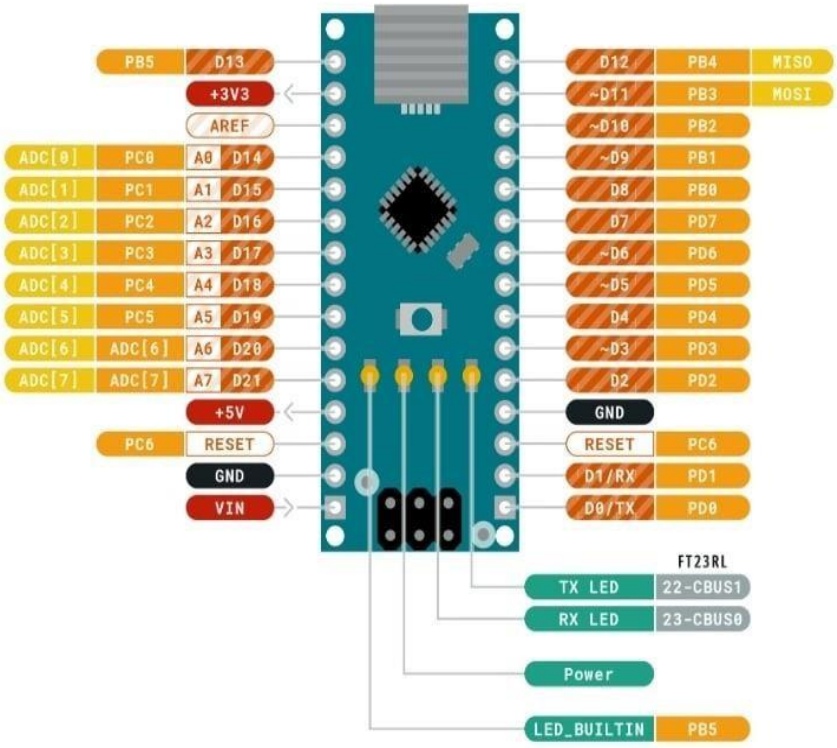

Figure 4.5: Pin Diagram

Description of pin diagram:

On our Nano board, there are a total of 8 analog pins and 14 digital pins. The digital pins can be utilized as output pins to operate loads or as input pins to communicate with sensors. To manage their functionality, utilize a straightforward method like pinMode() or digitalWrite(). For digital pins, the working voltage is 0V and 5V. Any of the 8 analog pins can measure analog voltage from 0V to 5V using a straightforward function called analogRead ().

4.1.7 Step by step robot constructing processes

While construction the robot we have followed some necessary steps. They are being described below:

4.1.7.1 Attach 4 while motor in chassis

Robot need to move from another place. So firstly, we attach motors in the chassis.

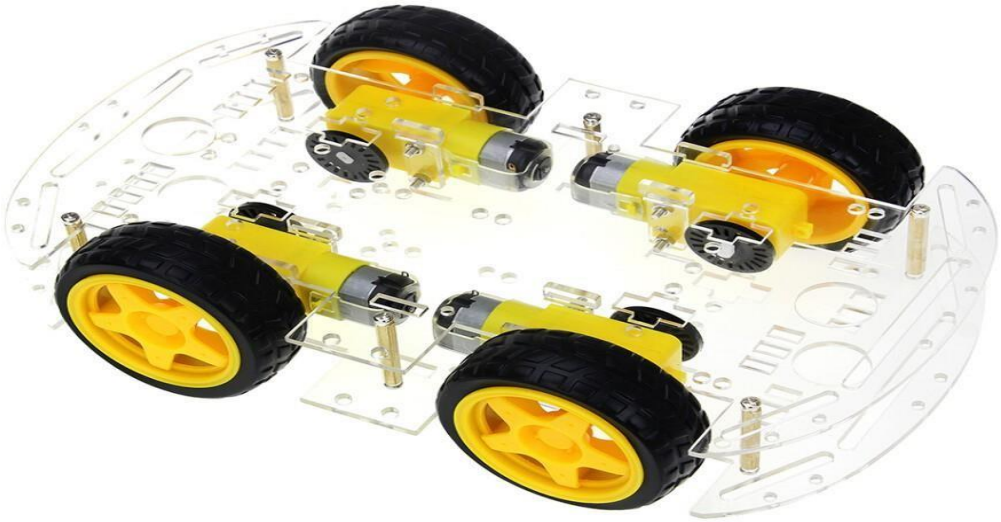

Figure 4.6: Attach while in chassis

4.1.7.2 Attach Battery cover in the chassis

We attach battery case upon the chassis. For the robot run or go to another place robot must need energy or power for run.

Figure 4.7: Attach Battery Case

4.1.7.3 Bread Board, DC Duck converter, and Stepper motor driver

For testing a simple circuit, we included a breadboard. They work well for separating DIP package ICs to jumper wires as well. These miniature breadboards can be connected to create longer pieces of board if you run out of space. It contains two mounting holes for M2 screws and a peel-and-stick adhesive backing so you can secure it.

Buck Converter, DC-DC Diminish Module LM2596 Power Supply is a step-down (buck) switching regulator that has excellent line and load regulation and can drive a 3-A load.

Driver boards are frequently used to manage DC motors, but they may also be used to manage stepper motors on a budget. Most steppers can have their speed and direction of rotation controlled.

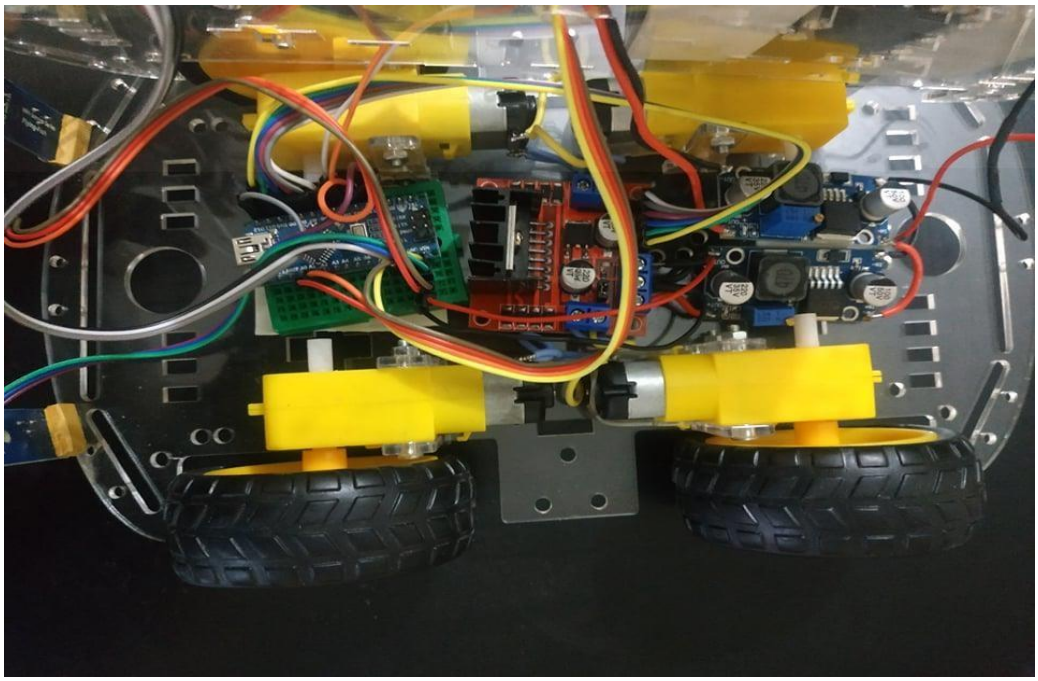

Figure 4.8: Bread Board, DC Duck converter & Stepper motor driver

4.1.7.4 Connecting IR Sensor

We added IR Sensor for follow the line and keep the place changing. Our robot basically moves to another place with follow the line and maintain the line.

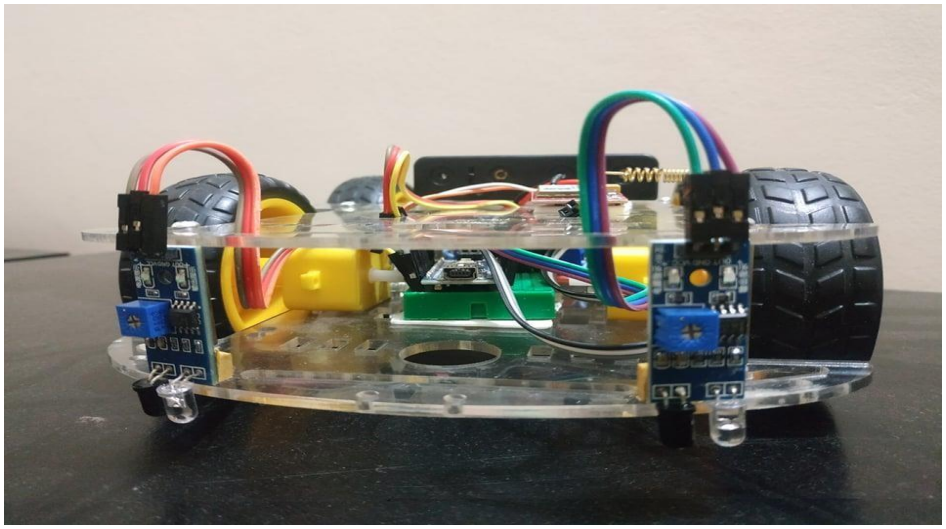

Figure 4.9: Connecting IR Sensor

4.1.7.5 Added Smart Car Mounted Holder

Then added smart car mounted holder for detect any object.

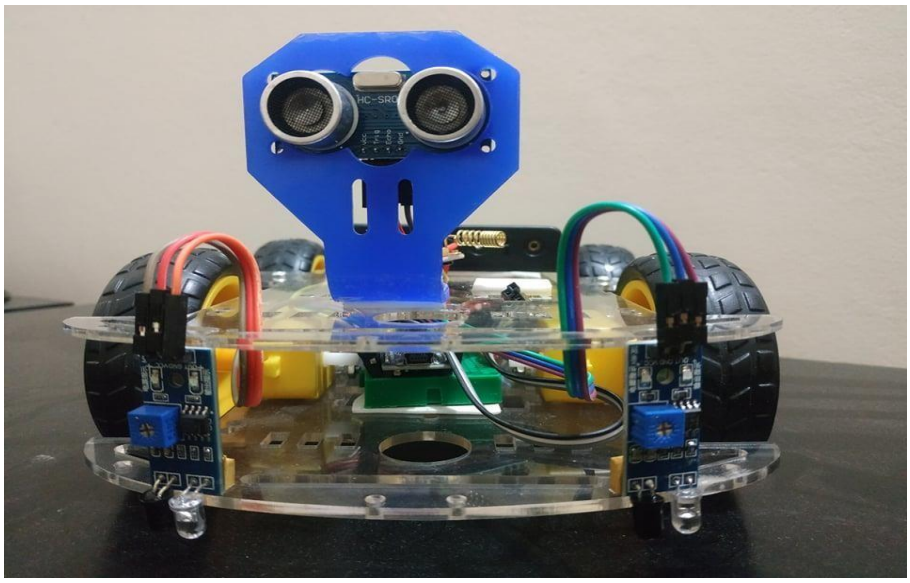

Figure 4.10: Connecting Mount Holder

4.1.7.6 Finally, SIM 800 L

The SIM800L is a tiny cellular module that supports GPRS transmission, SMS sending and receiving, and voice calls making and receiving. This module is the ideal choice for any project that needs long distance connectivity because of its low cost, compact size, support for four bands of frequencies, and low cost. The power module starts up after being

connected, looks for acellular network, and logs in automatically.

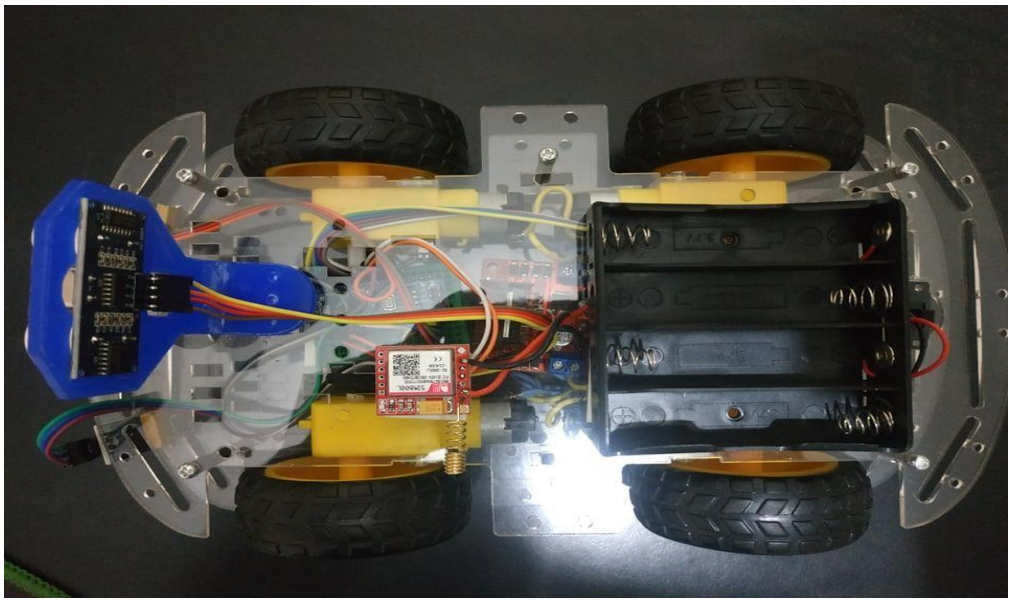

Figure 4.11: Added SIM 800 L

4.1.7.7 SMS Result

When robot detect any object then robot give us alert message for take an action.

Figure 4.12: SMS Result

4.2 Experimental Result & Analysis

4.2.1 Cost Analysis

4.2.1.1:

Table -2.1: Total Cost

Sl No.	Type of Cost	Our Project	Hou-Tsan Lee et al
1.	Parts and Materials	4000 BDT	9500 BDT
2.	Software Requirement	3000 BDT	4000 BDT
3.	Manufacture Process	2000 BDT	2500 BDT
4.	Vehicles	1500 BDT	2000 BDT
5.	Maintenance	2000 BDT	3000 BDT
Total Cost		12500 BDT	21000 BDT

Our Benefit 8500 BDT

So, we see that our Night Patrolling Robot is more costless then Hou-Tsan Lee et al Project.

4.2.2 Result Table

We tested the whole system 20 times restlessly as well as we successfully got 17 times correct result. So, the accuracy rate 62%.

Table-3.1: Result Table

Date	Total	success	Failure	Result Percentage
10-07-2022	06	02	04	Success 33%
15-07-2022	07	04	03	Success 57%
24-07-2022	10	06	05	Success 60%
28-07-2022	16	12	04	Success 75%
04-08-2022	20	17	03	Success 85%

Total average percentage of success is 62%.

4.2.3 Result Analysis

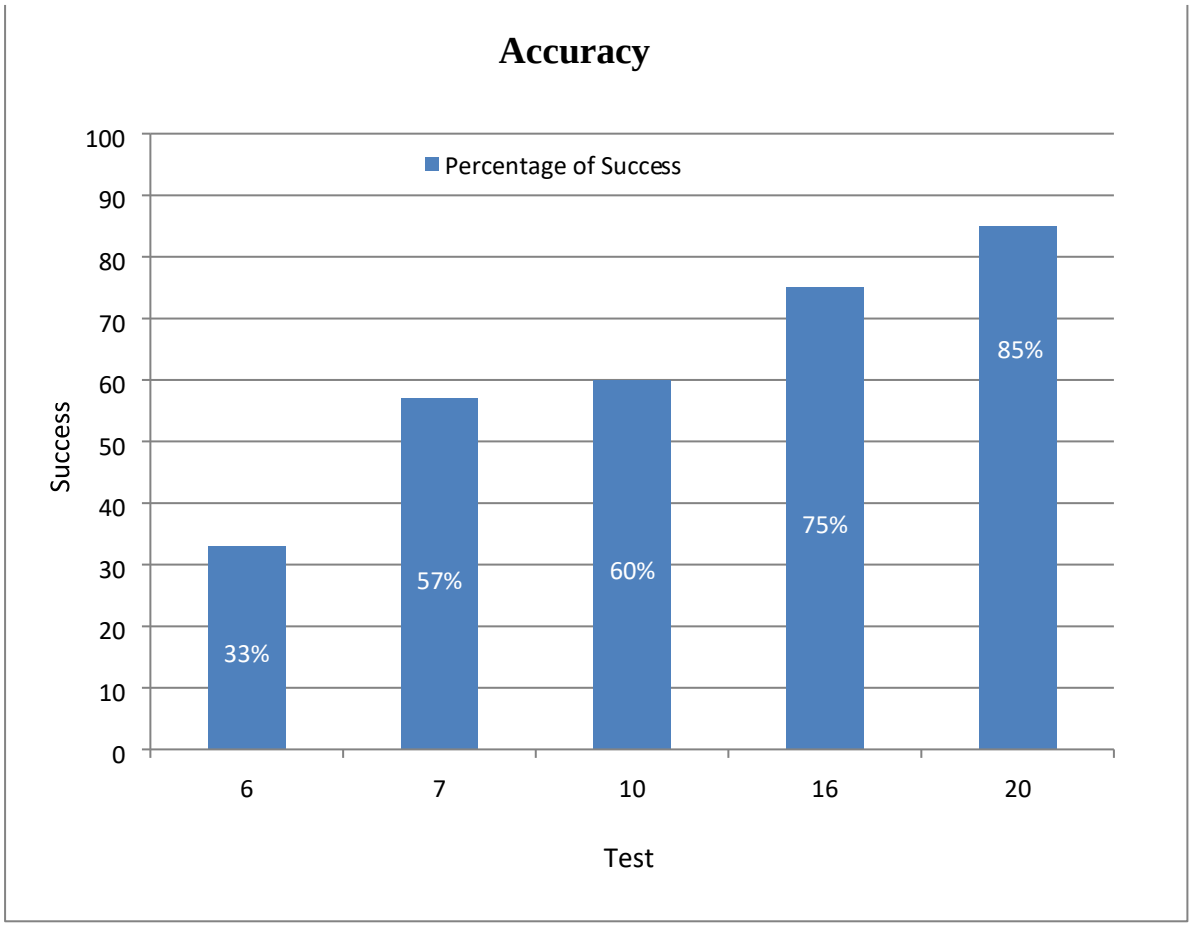

Figure 4.13: Graphical Representation

Description of Result Analysis:

We have tested whole system 20 times restlessly as well as successfully got 17 times correct. At first, we tested 6 times at this time our success 33%. Then we tested 7 times and success is 57%. Restlessly analysis 10 times tested the result is 60%. Continue process and last time we tested 20 times in this time our success of percentage is 85%.

Continue our analysis we got a satisfied result in our project. The total average percentage of our success is 62%.

CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

5.1 Impact on Society

Our night patrolling robot will have a great impact on the society. It will be able to ensure a safe and secure society. The rate of robbery and unwanted entering in the household can be prevented. People will be able to feel more safe in their household as well as in the society.

5.2 Impact on Environment

Our project also has a vital impact on the environment. As our project works on variety of places such as household, office, industry, shops so it ensure a safe and worried free environment.

5.3 Ethical Aspects

Through our night patrolling robot we are collecting or saving any kind of data from our users. Ethics focuses on the honesty or deceit of a matter. We are accepting accountability to protect the privacy of our consumers.

5.4 Sustainability Plan

Our sustainability strategy needs to be prioritized in accordance with its impact, effort, expense, and viability. Additionally, we need to think about the projects, people, resources, policies, supply chains, buildings, products, packaging, transportation, food, water, community, and employee health. In order for our project to be sustained over the long term and continue to operate, we need to consider various factors in our sustainability strategy.

CHAPTER 6

CONCLUSION

6.1 Conclusion

Today, we live in a robotics-based environment. Whether we are aware of it or not, we use various typing robots in our daily lives. The thesis seeks to assess what individuals can learn about engineering, mechatronics, and software development as they plan, build, and program a robot. This will serve as a manual for those who are new to the Arduino community and assist them in learning about embedded systems, sensors, microcontrollers, and how to build a robot using Arduino.

The folks who have a strong passion for and interest in Arduino robots will find this project to be of great assistance. The robot can be employed in daily life by individuals to do a variety of jobs as well as in real-world government defense surveillance.

6.2 Limitations

Project constraints may have an impact on how we manage our projects and even whether we decide to move on with them. Project restrictions commonly fall into a few types. By identifying these classifications. We can narrow the scope of our research to enhance the likelihood that we'll find every obstacle that affects our endeavor.The project has some limitations which are being mentioned below:

1. Robot can detect any human or any object.
2. It can’t battery power recharge automatically.
3. It can’t run without any selected line.
4. It can’t capture any picture.
5. Robot can’t start automatic.
6. Haven’t any android apps for control robot. It will run automatically.

6.3 Implication for Further Study

1. We will include a night vision camera for detect human and robot will avoid another object without human.

2. We also add full color display and a control unit so that we can show everything and control our robot.
3. We can add self-defending part in our robot.
4. Robot will run with a free position for better perform so that we patrol any place.
5. Increasing power backup by using solar panel and using high power lithium polymer battery.
6. We will add the face recognition.
7. We will add AI (Artificial intelligent) program for the better performance.

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DESIGN AND DEVELOPMENT OF AN IOT BASED NIGHT PATROLLING ROBOT

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