VISVESVARAYA TECHNOLOGICAL UNIVERSITY

JNANASANGAMA, BELAGAVI - 590018

A Mini-Project Report on

"DENSITY BASED TRAFFIC CONTROL SYSTEM USING INDUCTIVE LOOPS"

Submitted in partial fulfillment of requirement for the award of degree of

BACHELOR OF ENGINEERING

in

ELECTRICAL AND ELECTRONICS ENGINEERING

Submitted by

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CERTIFICATE

This is to certify that the Project work titled **"DENSITY BASED TRAFFIC CONTROL SYSTEM USING INDUCTIVE LOOPS"** carried out by Mouna Shree.L (USN:1BG19EE023), Vilesh Raj Belly (USN:1BG19EE050), Yashaswini P Raiker (USN:1BG19EE054), the bonafide students of **VI Semester B.E.**, B.N.M Institute of Technology, in partial fulfillment for the Bachelor of Engineering in **ELECTRICAL AND ELECTRONICS ENGINEERING** of the Visvesvaraya Technological University, Belagavi during the year 2021-2022. All the corrections / suggestions indicated for internal assessment have been incorporated in the report and have been approved as it satisfies the academic requirements in respect of **Mini-Project (18EEMP68)** prescribed for the said degree.

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DECLARATION

We Ms. Mouna Shree L (1BG19EE023), Mr. Vilesh Raj Belly (1BG19EE050) and Ms. Yashaswini P Raiker (1BG19EE054), hereby declare that the project work entitled "DENSITY BASED TRAFFIC CONTROL SYSTEM USING INDUCTIVE LOOPS" has been independently carried out by under the guidance of Mr. A Kumar, Associate Professor, Department Electrical & Electronics Engineering, B.N.M Institute of Technology, Bengaluru, in partial fulfillment of the requirements of the degree of Bachelor of Engineering in Electrical & Electronics Engineering of Visveswaraya Technological University, Belagavi

We further declare that we have not submitted this report either in part or in full to any other versity for the reward of any degree.

Mouna Shree L

Vilesh Raj Belly

Yashaswini P Raiker

Place: Bengaluru

Date:

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ABSTRACT

Through this project we present the use of inductive loops as an instrument to measure traffic density. A microcontroller can be programmed to receive information about traffic density on different lanes, as measured by the inductive loops. Algorithms that not only ease congestion but also ensure the people in less congested lanes don't have to wait too long are discussed. Depending upon the traffic density a suitable algorithm can be executed to clear the congestion. A new design of inductive loop to suit our algorithm in case of multiple lane traffic has also been discussed here. Apart from causing delay, many times traffic congestion has resulted in loss of precious lives since help isn't able to reach the needy on time. Overall, it is a complete model, one solution to many of traffic congestion related problems

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CHAPTER 1

INTRODUCTION

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INTRODUCTION

1.1 BACKGROUND

Traffic congestion is a worldwide problem. At times it can be very irritating to be stuck in traffic on a daily basis. In recent times, there has been a lot of talk regarding the need for a density-based traffic control system. It is believed that a density-based traffic control system can solve this worldwide problem.

Various algorithms have been developed based on different methods of traffic density monitoring like infra-red sensors, GPS systems, video cameras etc. With so much technology available at hand, inductive loops may now be labelled as outdated by many of us. But still, they undisputedly remain the best and the simplest method of vehicle detection. In this project there is an add-on on another dimension to the inductive loops using inductive loops as a tool to monitor traffic density. It also proposes to make use of one inductive loop in each lane to measure traffic density, Whenever the inductive loop senses the presence of a vehicle, the loop detector circuit output goes high.
The top view of placement of Inductive loops can be seen in figure 1.1.

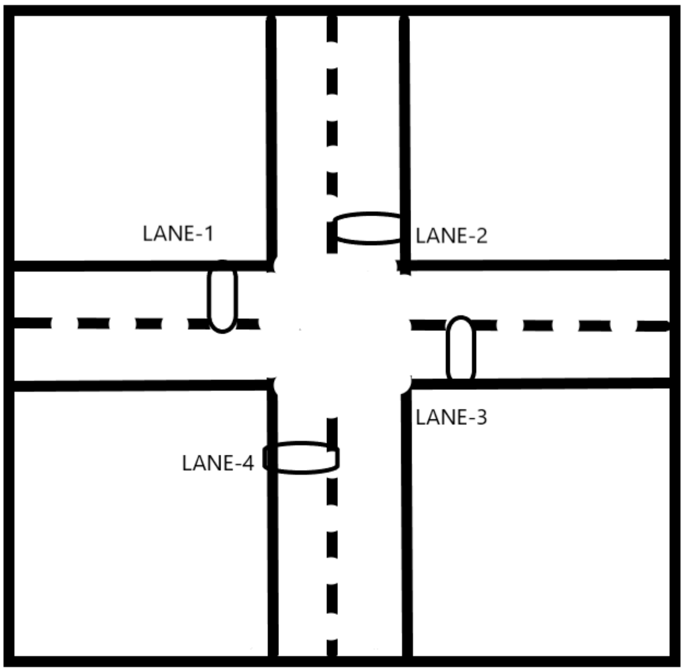

Figure 1.1: The arrangement of Loops

Suppose there are high vehicles at LANE-1 and minimum vehicles at the opposite lanes in such case the vehicles at LANE-1 will have green signal and opposite lanes will have to wait until the high traffic of LANE-1 gets cleared.

1.2 PROBLEM STATEMENT

Present Traffic Light Systems are programmed, at times this leads to consumption of unnecessary time for commuters in an intersection, this happens when there is green for an empty lane.

To Deal with this problem we have several methods such as,

- Image Processing Using Machine Learning
- Infrared and Ultrasonic
- Lasers
- Inductive Loops.

The main disadvantage of Image Processing is that it won't work during nights and rainy days. Infrared and Ultrasonic wave doesn't work efficiently at smog, sunlight, etc and also they damage eyes. And Lasers are highly expensive compared to others. Hence, we opt Inductive Loops as it is the most Logical and Economical technique which is embedded in the road's surface, it detects when a vehicle has arrived by detecting the change in the inductance.

CHAPTER 2

LITERATURE SURVEY

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

The following papers were referred to and surveyed for this project. Major learnings and insights from these research papers are jotted down in the further paragraphs.

2.2 FINDINGS FROM THE LITERATURE SURVEY

In [1] determination of vehicle density using inductive loops promises an effective way of controlling the traffic system. Parallel studies to the camera monitoring systems, Global Positioning System suggest that technology may offer advanced solutions however inductive loops supersedes all on the basis of its simplicity, cost-affectivity, easy-to-implement infrastructure with a good resistance to environmental deterrents. A traffic density-based microcontroller algorithm which takes into consideration the overall traffic condition of that junction and not just one lane at a time can provide a more practical and realistic solution to the problem of traffic congestion. Employing the Radio Frequency and infrared technology is helpful in dealing with detection of special vehicles and the problems faced by pedestrians thus saving money, time and lives of people along with maintaining orderly movement of traffic. The combination of all the above proposed features will offer very efficient traffic management system and is believed to bring a considerable positive change.

In [2] an automated vehicle detection system suitable for a heterogeneous and lane-less traffic condition has been a major stumbling block for the implementation of many Intelligent Traffic management System (ITS) applications in several countries. This paper presented a possible solution to this problem using a vehicle detection system based on a new multiple loop inductive sensor technique. The principle of operation of the proposed multiple loop inductive sensor is detailed herein. Test results from a prototype system developed are provided to establish the efficacy of the proposed method. The results show that the multiple inductive loop system sense and segregate the number of vehicles and their type. The developed inductive loop sensor detects large (e.g., bus) as well as small (e.g., bicycle) vehicles, thus making it suitable for heterogeneous traffic conditions. The proposed multiple loop system is useful for roads with any type of (with or without discipline and homogeneous or heterogeneous) traffic. The data provided by the measurement system is in digital form and hence, it is easy for transmission to traffic management centers for real-time applications. The developed system enables ITS implementations in countries with heterogeneous and lane-less traffic, resulting in better management of existing roadways with reduced congestion.

In [3] inductive loop detection systems are currently the most invested technology for obtaining traffic data in the U.S. and are widely deployed on most metropolitan freeway networks, potentially the ILD signature technology could become a key component of the advanced traffic management and traveler information systems. For example, section travel time and traffic speed generated from Traffic Monitor HD can be part of a traveler information system. Traffic management agencies (e.g., state DOTs) can display the travel time information on their variable message signs. Traffic information providers can provide the travel time and speed information to the general public as part of their services. Such information will become particularly important if severe congestion occurs.

In [4] In proposed classification system, the expensive piezoelectric sensors are replaced by the: cheaper inductive loops. In spite of this, the high classification efficiency can be preserved. The proposed algorithm bases only on signals from inductive loop detectors with properly selected dimensions. The influence of the loop length on chosen characteristics or parameters of magnetic profile has been analyzed. The bigger value of criterion (1) determined for vehicles belonging to different classes allows their more selective classification. Relatively big value of criterion for two different types of vehicles belonging to the same class means that possibility exists to differ between types of vehicles within the common class. Such results have been assigned for magnetic profile normalized in amplitude and transformed into vehicle length domain. Results of tests carried out indicate that for shorter loops criterion assigned bigger values. The very short loop (10cm) allows to detect number of axles and measure distance between them. It means that such loop can replace the system with two strip piezoelectric sensors and one long loop, and allow determine vehicle classes according to UE criterions. Simultaneously, additional information in magnetic profile can aid classification process.

CHAPTER 3

BLOCK DIAGRAM

CHAPTER 3

BLOCK DIAGRAM

The block diagram representation of the project is given below in the figure 3.1

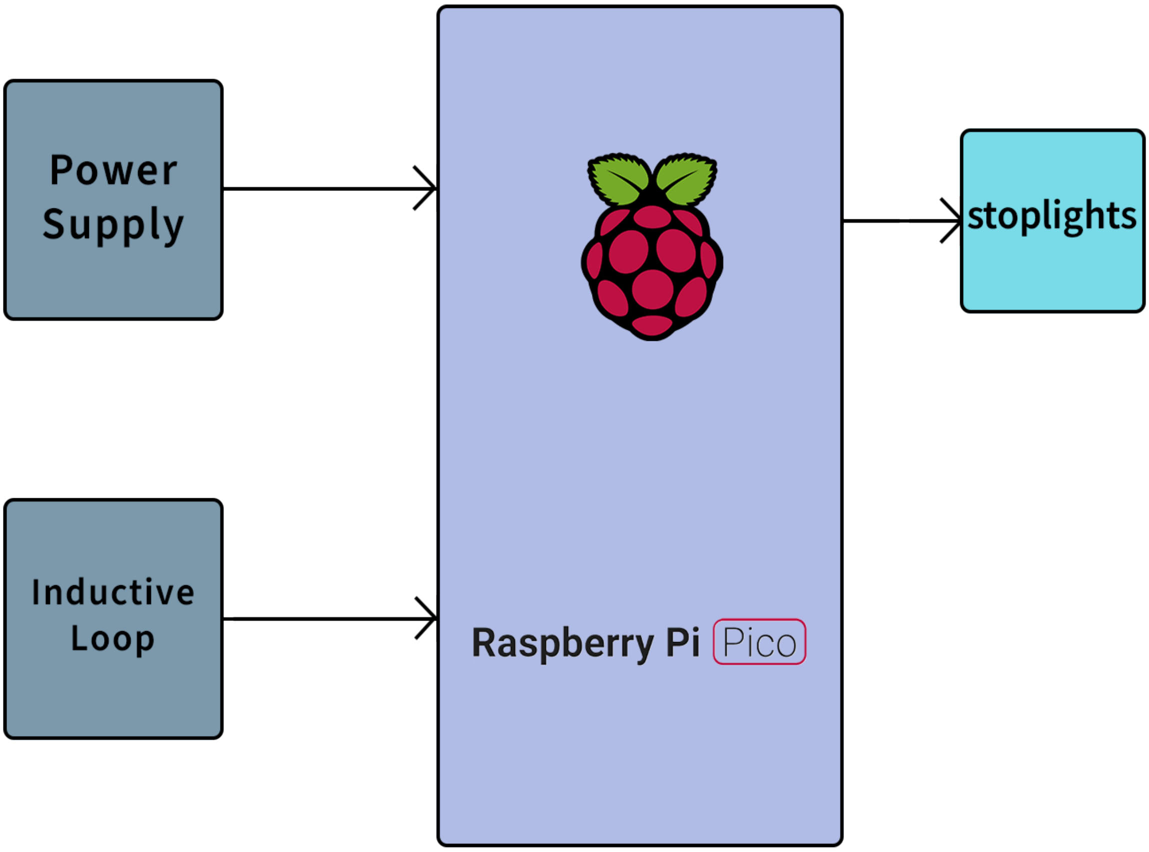

Figure 3.1: block diagram

A 3.3V power supply is given to pi-pico board, and the input is taken from multiple inductive loops and based on the logic of the code which is loaded on Raspberry Pi pico board the stop lights are controlled by taking continuous real time feedback to the system.

CHAPTER 4

REQUIREMENT ANALYSIS

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 HARDWARE REQUIREMENT

4.1.1 PI PICO

Raspberry Pi Pico is a low-cost, high-performance microcontroller board with flexible digital interfaces. Its specifications are given table 4.1 and pinout diagram are given the figure 4.1.

Table 4.1: Specifications of the Pico Board

Criteria	Value
Microcontroller Chip	RP2040
Clock Speed	133MHz
Flash Memory	2MB
On-Chip Memory	265KB
Power Supply	3.3V
USB port	Micro USB

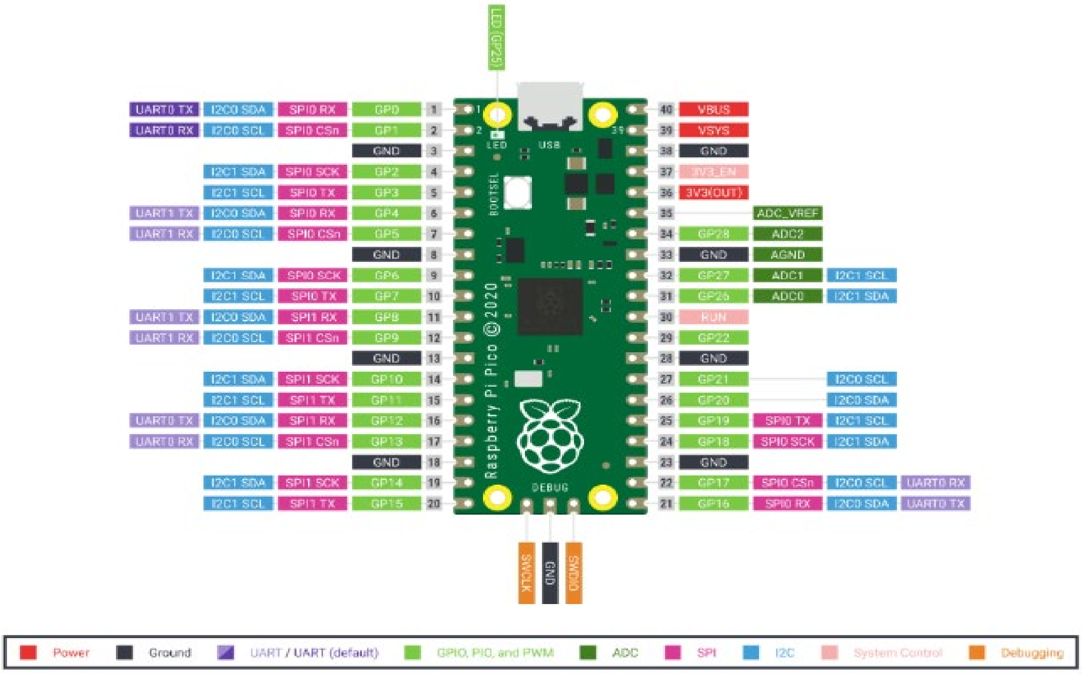

Figure 4.1: Pin out of Pi pico

4.1.2 A88 METAL DETECTOR INDUCTIVE LOOP

A88 Metal detector non-contact metal induction detection module makes a sound when it approaches any metal which operates by inducing currents in metal objects and responding when it occurs. The power cables of the Metal detector non-contact metal induction detection module will need soldering on for the module to function, positive to the outside of the module and negative between the potentiometer and an electrolytic capacitor. Its specifications are shown in table 4.2 and pinout diagram is show in Figure 4.2.

Table 4.2: Specifications of A88 Metal Detector Inductive Loop:

Criteria	Value
Input Voltage	DC 5V
Sensing Range	1CM
Operating Temperature	-15℃ ~ +70℃
Dimensions	66mm×60mm×14mm
Weight	15g

Figure 4.2: A88 Metal Detector Inductive Loop

4.1.3 PREF BOARD

Perf board is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perf board may have pads on only one side of the board, while better quality perf board can have pads on both sides (plate-through holes). Since each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made of paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminate (FR-4). Its pinout diagram is shown the figure 4.3.

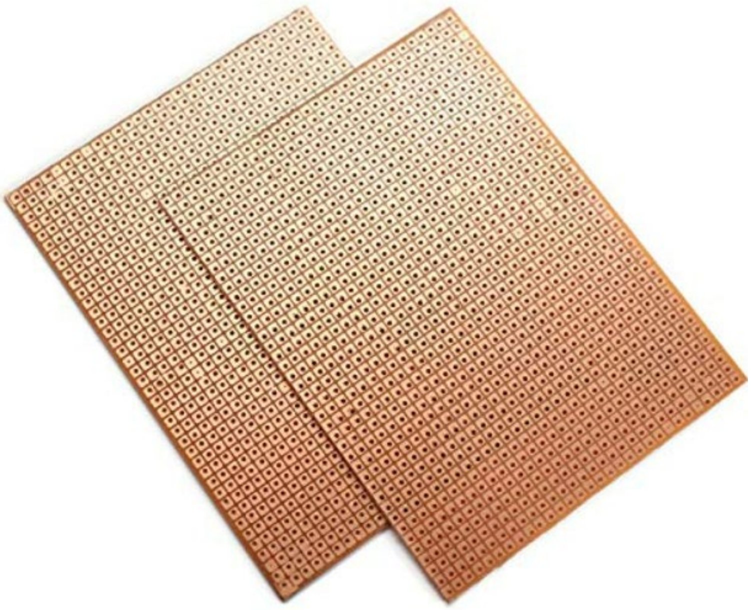

Figure 4.3: Pref Board

4.1.4 LED

Light-emitting diode (LED) is a widely used standard source of light in electrical equipment. It has a wide range of applications ranging from your mobile phone to large advertising billboards. They mostly find applications in devices that show the time and display different types of data. Its Specifications are shown in the table 4.3 and the image is shown in figure 4.4.

Table 4.3: Specifications of LEDs

Criteria	Value
Power Consume	200 milliwatts
Voltage Range	3.1-3.3V
Current Range	5-20 milliamperes
Output Power	150 milliwatts
Output Response	10 nanoseconds

Figure 4.4: LED

4.1.5 PIN HEADER

A pin header is a form of electrical connector. A male pin header consists of one or more rows of metal pins molded into a plastic base, often 2.54 mm (0.1 in) apart, though available in many spacings. Male pin headers are cost-effective due to their simplicity. The female counterparts are sometimes known as female socket headers, though there are numerous naming variations of male and female connector. Here Pin header is being used to connect perf board and pi pico, this set up is helpful to swap the board if required. The images of female and male header are shown in figure 4.5 and 4.6

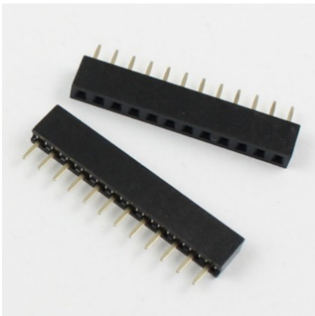

Figure 4.5: female socket headers

Figure 4.6: male pin header

4.1.6 MICRO USB CABLE

A micro-USB cable is the smallest form type of the Universal Serial Bus (USB) and comes with two connection types and USB 3.0. Micro USB cables provide convenient means to connect various devices and plug them into your chargers.

Micro USB cable is used to connect the pi pico board to Desktop. This Micro USB cable is used as it is the Universal connector. Image of usb shown in the figure 4.7.

Figure 4.7: Micro USB Cable

4.1.7 LEVEL SHIFTER

A level shifter, or logic-level shifter, is a circuit used to translate signals from one logic level or voltage domain to another. This allows compatibility between integrated circuits which operate at different voltages or have different voltage requirements, such as TTL and CMOS. Many modern devices use level shifters to translate voltage levels or bridge voltage domains between processors, sensors, logic integrated circuits, and other circuits. The most common logic level voltages currently are 1.8-Volts, 3.3-Volts, and 5-Volts. The image is shown in figure 4.9

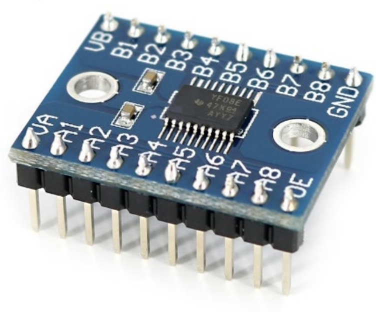

Figure 4.8: Level shifter

4.2 SOFTWARE REQUIREMENTS:

For this proposed model VS code was used as an editor with circuitpython extension, and thonny ide was used to build, run, and upload the code to the dev board.

4.2.1 Visual studio code

Visual Studio Code, also commonly referred to as VS Code, is a source code editor made by Microsoft for Windows, Linux and macOS Features include support for debugging, syntax highlighting , intelligent code completion, snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add additional functionality

Figure 4.9: logo of Visual Studio Code

4.2.2 Thonny ide

Thonny is an integrated development environment for Python that is designed for beginners. It supports different ways of stepping through the code, step-by-step expression evaluation, detailed visualization of the call stack and a mode for explaining the concepts of references and heap.

Figure 4.10: logo of Thonny ide

CHAPTER 5

SCHEMATIC DIAGRAM

CHAPTER 5

SCHEMATIC DIAGRAM

Easy EDA software was used to draw the schematic diagram of the project and it is shown in figure 5.1

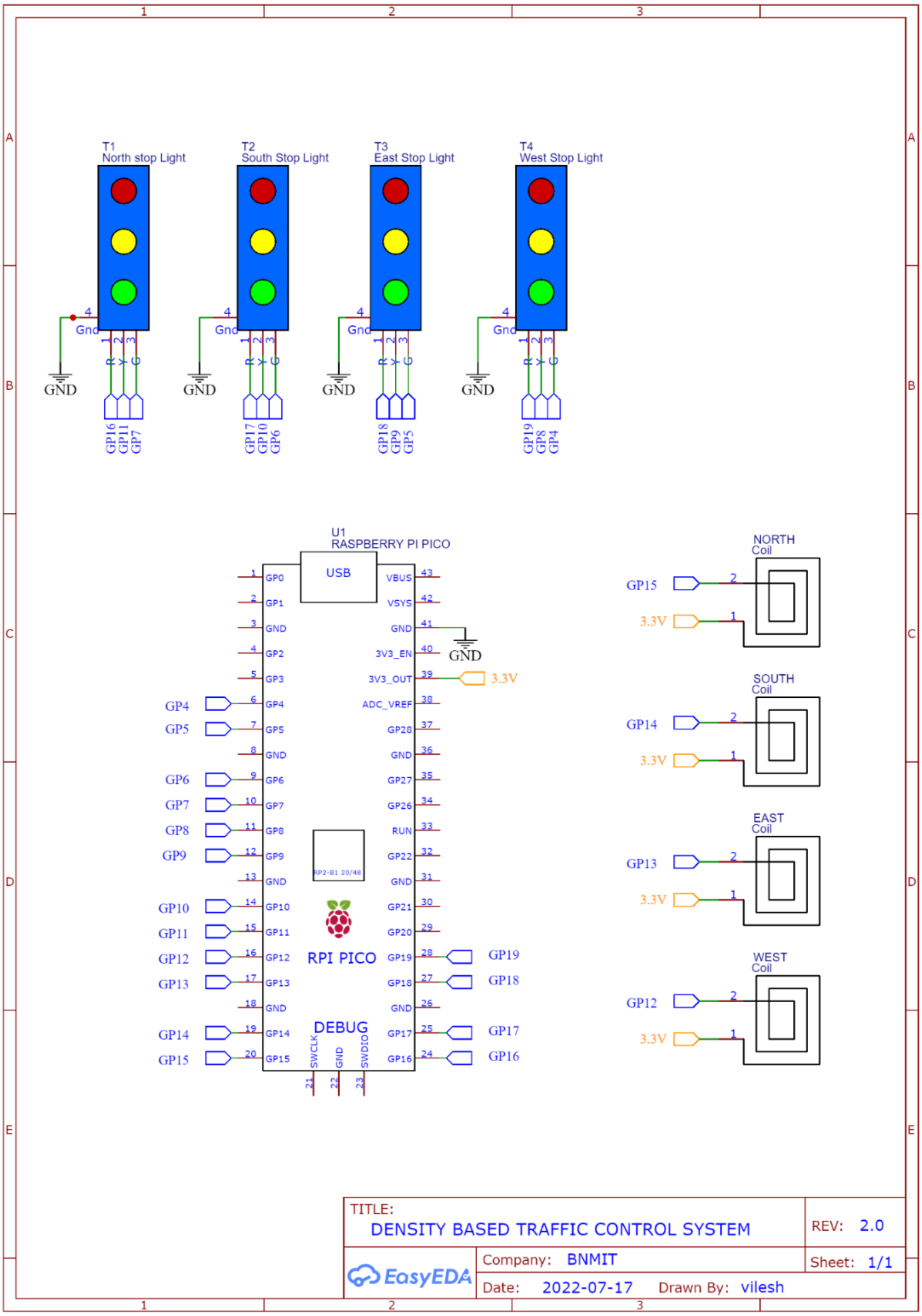

Figure 5.1: schematic diagram

CHAPTER 6

SYSTEM DESIGN

CHAPTER 6

SYSTEM DESIGN

6.1 FLOWCHART

The Flow of the code is shown in the figure 6.1

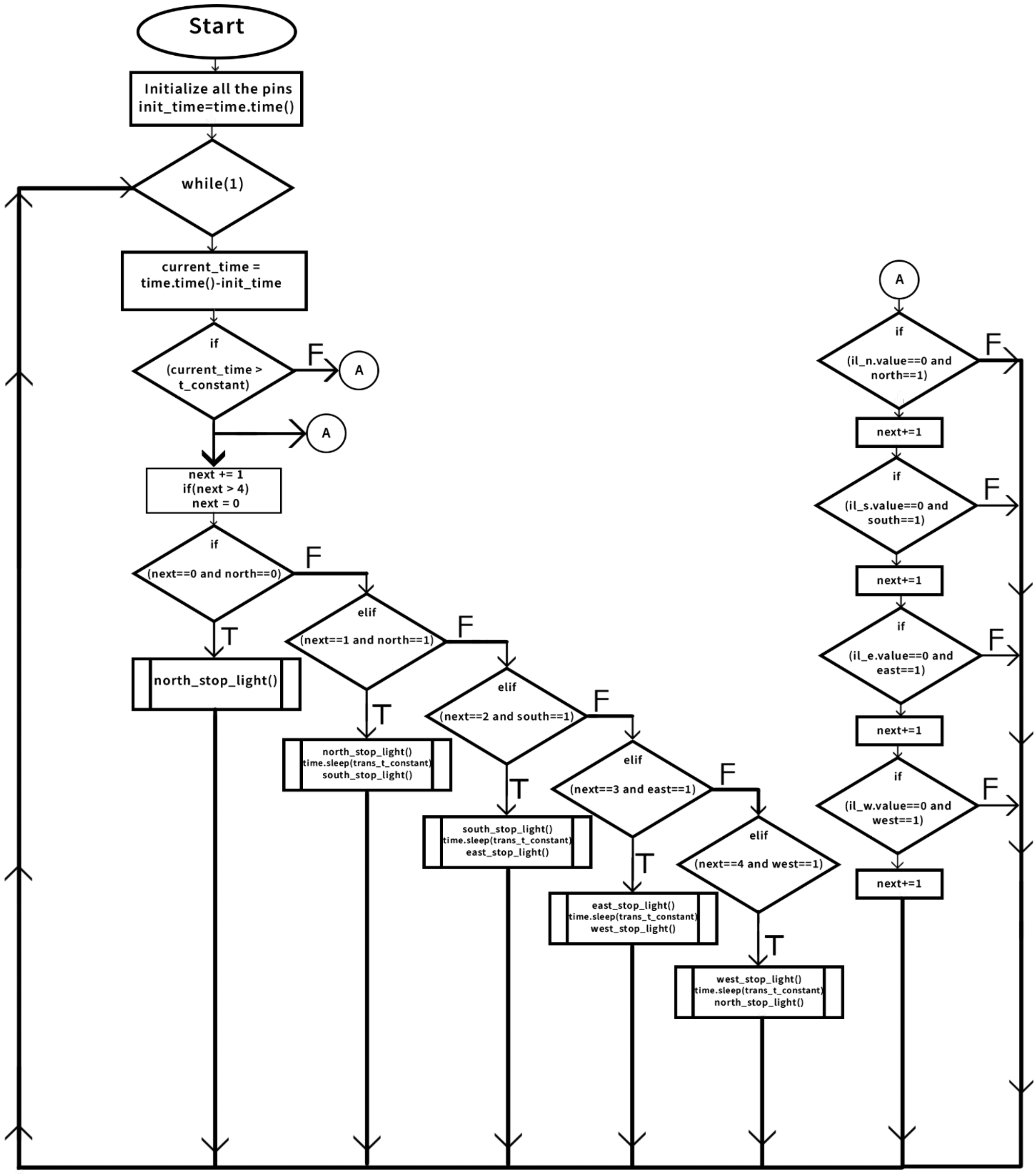

Figure 6.1: flowchart

6.2 CODE

The Program which is written in circuitpython for the project is given below

```
import digitalio
import board
import time
"""pins for the inductive loops """
il_p_n = board.GP15
il_p_s = board.GP14
il_p_e = board.GP13
il_p_w = board.GP12
"""pins for the red lights """
SL_north_red = board.GP16
SL_south_red = board.GP17
SL_east_red = board.GP18
SL_west_red = board.GP19
"""pins for the green lights """
SL_north_green = board.GP7
SL_south_green = board.GP6
SL_east_green = board.GP5
SL_west_green = board.GP4
"""pins for the amber lights """
SL_north_amber = board.GP11
SL_south_amber = board.GP10
SL_east_amber = board.GP9
SL_west_amber = board.GP8

trans_t_constant = 0.5

nt = st = et = wt = 1  # transition
north = south = east = west = False  # which direction is the car going
time_north = time_south = time_east = time_west = 0

ilp_n_t = ilp_s_t = ilp_e_t = ilp_w_t = 0
il_n_t = il_s_t = il_e_t = il_w_t = 0

next = 0

t_constant = 5

il_n_const = 2
il_s_const = 2
il_e_const = 2
il_w_const = 2
```

```
il_n = digitalio.DigitalInOut(il_p_n)
il_n.direction = digitalio.Direction.INPUT
il_n.pull = digitalio.Pull.DOWN

il_s = digitalio.DigitalInOut(il_p_s)
il_s.direction = digitalio.Direction.INPUT
il_s.pull = digitalio.Pull.DOWN

il_e = digitalio.DigitalInOut(il_p_e)
il_e.direction = digitalio.Direction.INPUT
il_e.pull = digitalio.Pull.DOWN

il_w = digitalio.DigitalInOut(il_p_w)
il_w.direction = digitalio.Direction.INPUT
il_w.pull = digitalio.Pull.DOWN

SL_north_red = digitalio.DigitalInOut(SL_north_red)
SL_north_red.direction = digitalio.Direction.OUTPUT

SL_south_red = digitalio.DigitalInOut(SL_south_red)
SL_south_red.direction = digitalio.Direction.OUTPUT

SL_east_red = digitalio.DigitalInOut(SL_east_red)
SL_east_red.direction = digitalio.Direction.OUTPUT

SL_west_red = digitalio.DigitalInOut(SL_west_red)
SL_west_red.direction = digitalio.Direction.OUTPUT


SL_north_green = digitalio.DigitalInOut(SL_north_green)
SL_north_green.direction = digitalio.Direction.OUTPUT

SL_south_green = digitalio.DigitalInOut(SL_south_green)
SL_south_green.direction = digitalio.Direction.OUTPUT

SL_east_green = digitalio.DigitalInOut(SL_east_green)
SL_east_green.direction = digitalio.Direction.OUTPUT

SL_west_green = digitalio.DigitalInOut(SL_west_green)
SL_west_green.direction = digitalio.Direction.OUTPUT


SL_north_amber = digitalio.DigitalInOut(SL_north_amber)
SL_north_amber.direction = digitalio.Direction.OUTPUT

SL_south_amber = digitalio.DigitalInOut(SL_south_amber)
SL_south_amber.direction = digitalio.Direction.OUTPUT
```

```
SL_east_amber = digitalio.DigitalInOut(SL_east_amber)
SL_east_amber.direction = digitalio.Direction.OUTPUT

SL_west_amber = digitalio.DigitalInOut(SL_west_amber)
SL_west_amber.direction = digitalio.Direction.OUTPUT


SL_north_red.value = SL_south_red.value = SL_east_red.value = SL_west_red.value
= False
SL_north_green.value = SL_south_green.value = SL_east_green.value =
SL_west_green.value = True
SL_north_amber.value = SL_south_amber.value = SL_east_amber.value =
SL_west_amber.value = False
time.sleep(0.5)

SL_north_red.value = SL_south_red.value = SL_east_red.value = SL_west_red.value
= False
SL_north_green.value = SL_south_green.value = SL_east_green.value =
SL_west_green.value = False
SL_north_amber.value = SL_south_amber.value = SL_east_amber.value =
SL_west_amber.value = True
time.sleep(0.5)

SL_north_red.value = SL_south_red.value = SL_east_red.value = SL_west_red.value
= True
SL_north_green.value = SL_south_green.value = SL_east_green.value =
SL_west_green.value = False
SL_north_amber.value = SL_south_amber.value = SL_east_amber.value =
SL_west_amber.value = False
time.sleep(0.5)


def north_stop_light():
    global nt, SL_north_red, SL_north_amber, SL_north_green, north, ilp_n_t
    if(north == False):  # red to green
        SL_north_red.value = False
        SL_north_amber.value = True
        time.sleep(1)
        SL_north_green.value = True
        SL_north_amber.value = False
        ilp_n_t = time.time()
        north = True
    elif(north == True):  # green to red
        SL_north_green.value = False
        SL_north_amber.value = True
        time.sleep(1)
```

```
        SL_north_red.value = True
        SL_north_amber.value = False
        north = False


def south_stop_light():
    global st, SL_south_red, SL_south_amber, SL_south_green, south, ilp_s_t
    if(south == False):  # red to green
        SL_south_red.value = False
        SL_south_amber.value = True
        time.sleep(1)
        SL_south_green.value = True
        SL_south_amber.value = False
        ilp_s_t = time.time()
        south = True
    elif(south == True):  # green to red
        SL_south_green.value = False
        SL_south_amber.value = True
        time.sleep(1)
        SL_south_red.value = True
        SL_south_amber.value = False
        south = False


def east_stop_light():
    global et, SL_east_red, SL_east_amber, SL_east_green, east, ilp_e_t
    if(east == False):  # red to green
        SL_east_red.value = False
        SL_east_amber.value = True
        time.sleep(1)
        SL_east_green.value = True
        SL_east_amber.value = False
        ilp_e_t = time.time()
        east = True
    elif(east == True):  # green to red
        SL_east_green.value = False
        SL_east_amber.value = True
        time.sleep(1)
        SL_east_red.value = True
        SL_east_amber.value = False
        east = False


def west_stop_light():
    global wt, SL_west_red, SL_west_amber, SL_west_green, west, ilp_w_t
    if(west == False):  # red to green
        SL_west_red.value = False
```

```
        SL_west_amber.value = True
        time.sleep(1)
        SL_west_green.value = True
        SL_west_amber.value = False
        ilp_w_t = time.time()
        west = True
    elif(west == True):  # green to red
        SL_west_green.value = False
        SL_west_amber.value = True
        time.sleep(1)
        SL_west_red.value = True
        SL_west_amber.value = False
        west == False

north_stop_light()
init_time = time.time()
############################################################################
while True:
    current_time = time.time()-init_time
    if(current_time > t_constant):
        next += 1
        if(next > 4):
            next = 0

        init_time = time.time()

    time.sleep(0.1)
    print(current_time)
    print("next", next)

    if(il_n.value == False and north == True):
        il_n_t = time.time()-ilp_n_t
        if(il_n_t > il_n_const):
            next += 1
    else:
        ilp_n_t = time.time()

    if(il_s.value == False and south == True):
        il_s_t = time.time()-ilp_s_t
        if(il_s_t > il_s_const):
            next += 1
    else:
        ilp_s_t = time.time()

    if(il_e.value == False and east == True):
        il_e_t = time.time()-ilp_e_t
        if(il_e_t > il_e_const):
```

```
            next += 1
    else:
        ilp_e_t = time.time()

    if(il_w.value == False and west == True):
        il_w_t = time.time()-ilp_w_t
        if(il_w_t > il_w_const):
            next += 1
    else:
        ilp_w_t = time.time()

    if(next == 0 and north == False):
        north_stop_light()

    elif(next == 1 and north == True):
        north_stop_light()  # north off
        time.sleep(trans_t_constant)
        south_stop_light()  # south on

    elif(next == 2 and south == True):
        south_stop_light()  # south off
        time.sleep(trans_t_constant)
        east_stop_light()  # east on

    elif(next == 3 and east == True):
        east_stop_light()  # east off
        time.sleep(trans_t_constant)
        west_stop_light()  # west on

    elif(next == 4 and west == True):
        west_stop_light()  # west off
        time.sleep(trans_t_constant)
        north_stop_light()  # north on
```

CHAPTER 7

RESULT

CHAPTER 7

RESULT

The proposed work was implemented. Appropriate software codes were written using Visual studio code, and the Hardware which includes Inductive loops and pi pico board and other electronic components were interfaced. When tested, the results were found to be satisfactory as per the design requirements. This is shown in the figures 7.1, 7.2 & 7.3.

Here the proposed project helps in clearing the congestion by reducing the amount of green light signal time on the empty lane which in turn is giving an extra average time for the other non-empty lanes to clear up the congestion.

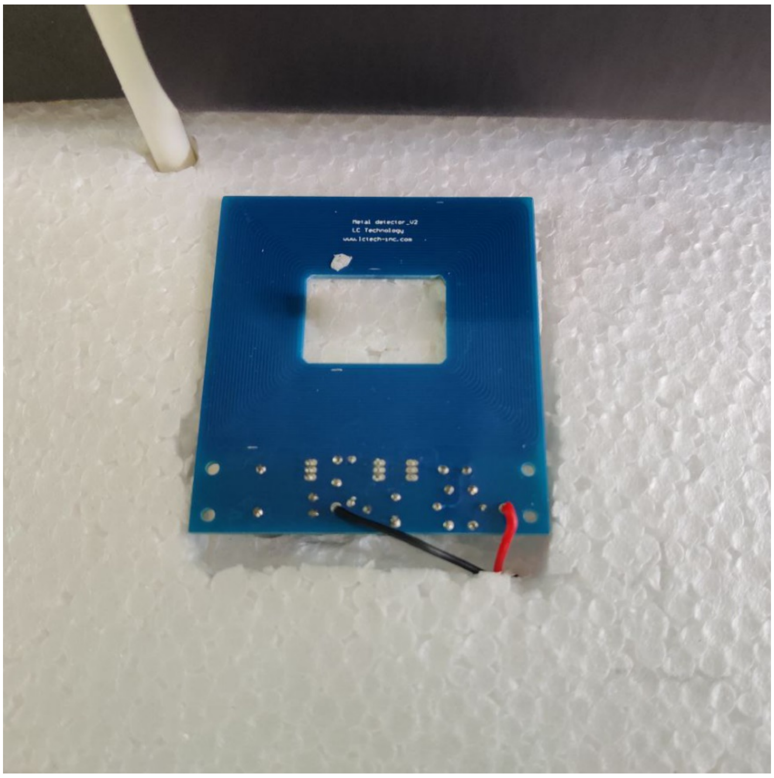

Figure7.1: Inductive loop.

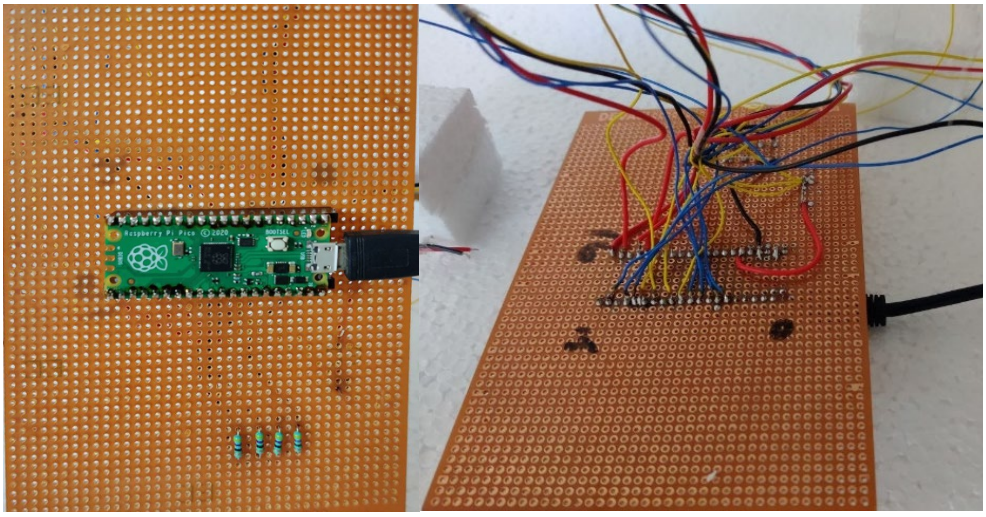

Figure 7.2: Perf board with pi pico soldere

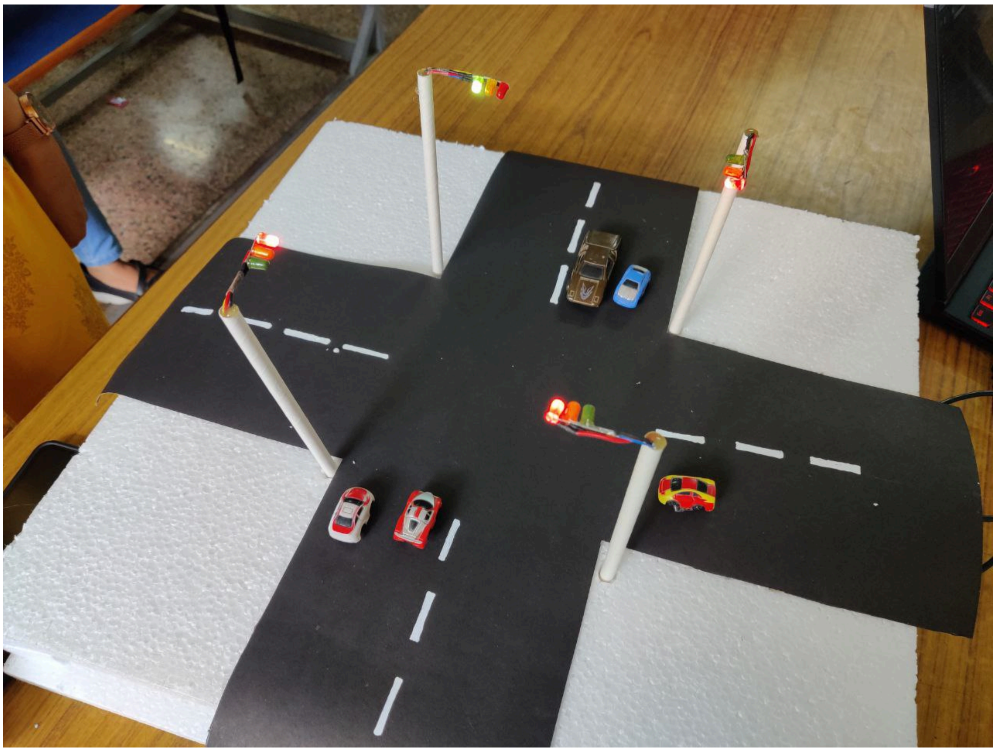

Figure7.3: Final model of the work

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

The work was implemented using Raspberry Pi pico microcontroller board, inductive loops, and other electronic components. Here the functioning of Inductive loops was tested having different density and verified where the time of the signal on and off period varied based on the real time input and the results was found to be satisfactory.

In Future, multiple inductive loops on a single lane at appropriate distance can be used to enlarge the area feedback to have a Precise and more effective closed loop system.

CHAPTER 9

REFERENCE

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REFERENCE

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