

AUTOMATIC TRAFFIC LIGHT MANAGEMENT SYSTEM FOR PEDESTRIAN CROSSING

Submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in ELECTRONICS AND COMMUNICATION ENGINEERING

By

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

This is to certify that this Project Report is the bonafide work of **A.ABHISHEK (37130035)** who carried out the project entitled “**AUTOMATIC TRAFFIC LIGHT MANAGEMENT SYSTEM FOR PEDESTRIAN CROSSING**” under our supervision from DECEMBER 2020 to APRIL 2021.

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I, **A.ABHISHEK** hereby declare that the Project Report entitled **“AUTOMATIC TRAFFIC LIGHT MANAGEMENT SYSTEM FOR PEDESTRIAN CROSSING”** done by me under the guidance of **Dr. U.ANITHA, M.E., Ph.D**, is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **ELECTRONICS AND COMMUNICATION ENGINEERING**.

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ABSTRACT

In the last few years, numerous research efforts have been experimented to merge the wireless communication (Zigbee) with smart city environments. The goal is to make a city “smart” in arising as a possible solution to lessen the issues caused by the urban population growth and fast urbanization. Attention also has been focused on the pedestrian crossings because they are one of the most dangerous places in transport field. Wireless communication can undoubtedly be an excellent support in developing infrastructures that can best manage the pedestrian crossing.

For this reason, this project introduces a portable smart wireless control system for pedestrian crossing areas to manage the traffic automatically and allow the pedestrian, like school children, to cross the road safely and effortlessly. The system incorporates the concept of smart sensing to detect the presence of pedestrians and in turn, automatically controls the crosswalk of the traffic lights. The system composes of two Arduino microcontrollers, two IR sensors, and a bidirectional wireless communication link based on Zigbee for mitigating wiring installation and transmitting the signal among traffic light units on both roadsides.

The system is assembled and implemented as a portable LED-based traffic light testbed. The developed system is tested and validated in a real environment with in a 6 m road width on the university campus. According to the obtained results, the system worked effectively and fulfilled the design criteria where the communication between both sides lights is successfully functioning and the IR sensors can accurately detect the existence of pedestrians. The developed system is cost-effective, energy efficient, easy to install, and free maintenance.

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ABSTRACT	(v)
	LIST OF FIGURES	(ix)
	LIST OF TABLES	(xi)
1	INTRODUCTION	1
	1.1 Embedded System	2
	1.1.1 Embedded system Hardware	2
	1.1.2 Embedded system Software	4
	1.1.3 Embedded Firmware	5
	1.1.4 Embedded System vs VLSI	6
	1.1.5 Debugging Embedded system	6
2	LITERATURE SURVEY	8
3	MATERIALS AND METHODS	12
	3.1 Existing System	12
	3.1.1 Disadvantages of Existing System	12
	3.2 Proposed System	12
	3.2.1 Advantages of Proposed System	12

CHAPTER NO.	TITLE	PAGE NO.
	3.2.2 Block Diagram of Proposed System Transmitter Side	13
	3.2.3 Block Diagram of Proposed System Receiver Side	14
	3.2.4 Description Of Block Diagram	15
3.3	Hardware Description	15
	3.3.1 Arduino UNO	15
	3.3.2 Arduino Board	17
	3.3.3 Features of Arduino	18
3.4	IR Sensor	19
	3.4.1 IR Sensor Circuit Diagram and Working Principle	20
	3.4.2 Different Types of IR Sensor	22
	3.4.3 IR Sensor Applications	22
	3.4.4 Flame Monitors	23
	3.4.5 Moisture Analyzers	23
	3.4.6 Gas Analyzers	23
	3.4.7 IR Imaging Devices	24
3.5	ZIGBEE	25
	3.5.1 ZigBee Modem	27
	3.5.2 Physical Layer of ZigBee	29
	3.5.3 MAC layer	29
	3.5.4 Network Layer	30
	3.5.6 Application Framework	30
	3.5.7 Mesh Networking Topology in ZigBee	31
	3.5.8 Specifications of ZigBee	32

CHAPTER NO.	TITLE	PAGE NO.
	3.5.9 Advantages of ZigBee	32
	3.5.10 Disadvantages of ZigBee	33
	3.5.11 Applications of ZigBee	33
	3.6 LED	34
	3.6.1 Types of LED	35
	3.6.2 LED Miniature	35
	3.6.3 High Power LED	36
	3.6.4 AC Driven LED	36
	3.6.5 Application Specific Variations	37
	3.7 Software Requirements	40
	3.7.1 Arduino UNO	41
	3.7.2 Embedded C	42
	3.7.3 Basic Additional Features of Embedded Software	44
	3.7.4 The Structure of an Embedded C Program	46
4	RESULT AND DISCUSSIONS	47
5	CONCLUSION	49
	REFERENCES	50

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1.1	Embedded System	3
1.2	RISC Architecture	4
3.1	Block Diagram of Proposed System Transmitter Side	13
3.2	Block Diagram of Proposed System Receiver Side	14
3.3	Arduino UNO	17
3.4	Arduino UNO with Digital Input/Output	18
3.5	Pin Diagram of Arduino UNO	19
3.6	IR Sensor	20
3.7	Circuit Diagram of IR sensor	21
3.8	Gas Analyzer	24
3.9	IR Imaging Devices	25
3.10	Zigbee	26
3.11	Zigbee Modem	27
3.12	Zigbee Architecture	27
3.13	Zigbee Protocol Architecture	28
3.14	Physical Layer of Zigbee Protocol	29

FIGURE	TITLE	PAGE
NO.		NO.
3.15	RGB Tri-color	38
3.16	Alpha Numeric	39
4.1	Practical Image	50

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
3.1	Keywords	44

CHAPTER 1

INTRODUCTION

Road users must stop or return to soccer players crossing the road at a marked crossing without regulation, according to state driving laws. However, several cars have been discovered in the real world that refuse to yield to farmers, resulting in a vehicle-to-foot fight. According to the National Highway Traffic Safety Administration's 2016 Transit Safety Facts, 1,050 pedestrians and 240 cyclists were killed at intersections in 2016, accounting for 17.5 percent of fatal accidents involving footbridges and 28.5 percent of fatal accidents overall (NHTSA). Various countermeasures have been developed to reduce the likelihood of conflict at these locations. This is commonly used in strategies such as "Pathway" signs, the construction of torsion strips to reduce vehicle speed, the introduction of red and amber signals, the use of RFB, and so on. Often used are RFBs. In the United States, the addition of RRFB is becoming increasingly common as part of these countermeasures. The inclusion of the RRFB is intended to boost the rate of return for pedestrian vehicles. At least two rectangular yellow indicators with fast and alternating pulse light sources array-based flashes make up the RRFB. Radiofrequency transmitters and receivers will link this device to the machine on the other side of the street. Based on the crossing length and the predetermined flash after each actuation, the RRFB flash time is calculated in advance. The RRFB is appropriate for areas where there is already a marked crossing but there are uncontrolled pedestrian crossings that need traffic light installation. Many studies have been carried out to assess the efficacy of RRFBs. Based on the results of previous research.

1.1 EMBEDDED SYSTEM:

A programmable or able to perform a specific process or operation within a larger system, an integrated device is a combination of computer hardware and software. Industrial machinery, agricultural and process equipment, automobiles, medical equipment, cameras, household appliances, aircraft, selling tools, toys, and mobile devices are examples of embedded machines.

Embedded systems, which include mobile devices, are operating systems with a single usable application varying from no UI to sophisticated graphical user interfaces (GUIs). The user interfaces include buttons, LEDs, touch screen sensing, and more. Remote user interfaces are still used by several computers.

1.1.1 Embedded computer hardware (microprocessor-based, microcontroller-based)

Embedded hardware for microcontroller or microprocessor applications. In any case, the product is typically designed to perform real-time heart calculations. In terms of graphics, microprocessors and microcontrollers are similar, but microcontrollers have been designed for self-contained systems, while microprocessors only have a central processing unit (CPU) and require external components such as memory chips.

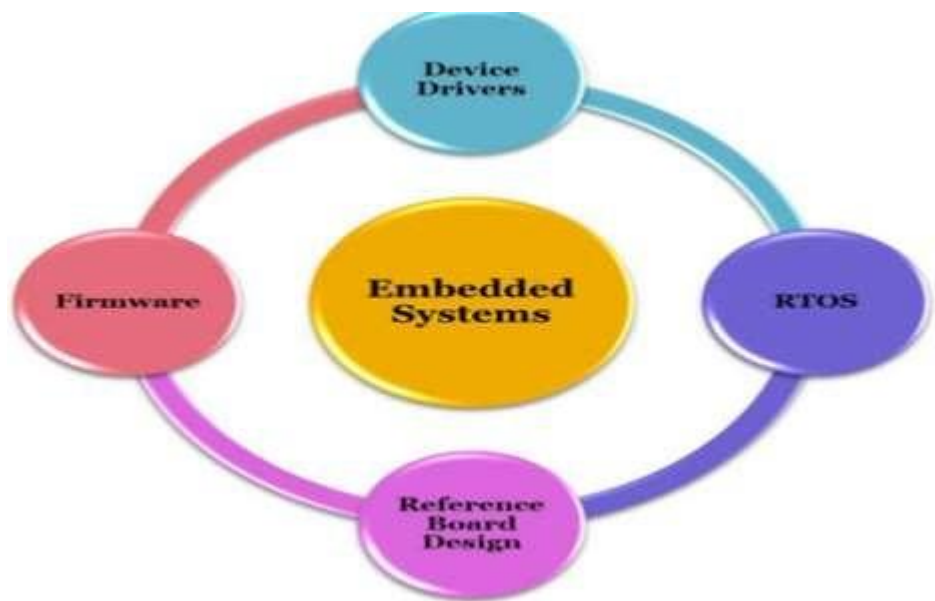


Fig 1.1 Embedded System

Microcontrollers also have flash memory, RMA, serial communication, CPU ports, memory, and peripherals. Microcontrollers are used for more complex tasks because they perform extensive (if relatively low) programmes. Microcontrollers are used in a variety of applications, including automobiles, robots, medical devices, and home appliances. On the chip (SoC) at the upper end of the microcontroller feature, the term device is often used, but there is no specific RAM, clock speed, or other lineup.

By 2013, the integrated industry is expected to be worth more than 140 billion dollars, with some experts predicting a market worth more than 20 billion dollars by 2020. Apple, IBM, Intel, and Texas Instruments are only a few of the companies that make embedded chips. Arm is a major player in this business. The company was founded by Acorn, a pioneering British PC maker. Arm chips, which are manufactured under licence by other companies and are based on the RISC

architecture, are the most widely used embedded SoCs in the world, with trillions of units sold.



Fig 1.2 RISC Architecture

1.1.2 Embedded system software

A conventional industrial microcontroller operates in a less memory-intensive environment than a typical business desktop computer. The most basic devices run on bare metal and are programmed in the chip CPU's machine code language.

Integrated specialised operating systems or language platforms are used for entering systems in a variety of cases, especially when operational conditions must be served in real time. Designers used devices that are tolerant of small reaction time shifts, making them suitable for fast-real-time approaches at higher chip capabilities like SOCs. A standard Linux download, while other operating systems, such as Java and

Windows IoT, are tightly coupled to embedded device functionality (formerly Windows Embedded).

For programme or operating system storage in embedded computers, generals use flash or rewritable flash memory.

1.1.3 Embedded firmware

Firmware is a form of software that is written in a computer and has ROM functions, but it is easier to modify with embedded systems. Embedded firmware is another name for this firmware. Non-volatile storage devices such as ROM, ROM, and erasable PROMs may have their firmware saved. Embedded firmware is used to keep track of various computer and system features, such as informing the user of how to communicate with other devices.

The distinction between embedded firmware and embedded software is established, but embedded software refers to a single piece of hardware code, while firmware refers to a chip that is linked to a piece of software through a BIOS or UEFI system.

1.1.4 Embedded systems vs. VLSI

VLSI stands for very large scale integration, and it refers to the sophistication of an integrated circuit. LSI (large integrated) microchips have thousands of transistors, MSI and SSI chips have hundreds of transistors, and VLSI chips have hundreds of transistors. The ULSI is an ultra-large integration that necessitates the packaging of millions of transistors on a single chip.

VLSI circuits are a standard feature of embedded systems. VLSI is widely used in embedded systems, but its use is typically unfavourable.

1.1.5 Debugging embedded systems

Debugging is an area in which large-scale computers and embedded systems collaborate on operating and development systems. Embedded computer programmers usually don't, while desktop programmes have systems that can run developed code and a variety of debugging applications that monitor development code enforcement.

Some languages run well on microcontrollers, allowing for basic interactive chip debugging. Via a JTAG or similar debugging port, processors can also track CPU debuggers and control programme performance.

Installed device programmers, on the other hand, need tools to link a separate debugging system to the target system via a serial port or other port. If this happens, you'll be able to display the source code on your laptop screen, which is very similar to what you'd see when debugging desktop apps. Another approach is used to run software on a PC that emulates the software's physical chip, allowing the software to debug its performance as if it were on an actual, physical chip.

Given the large variety of devices that use embedded controls, embedded systems are normally managed and debugged with greater caution in circumstances requiring high safety and reliability.

The Internet of Things is built on an interconnected framework: while some embedded systems are relatively easy, a growing number can either replace human decision-making or produce more than a human could. Some aircraft systems, such

as drones, can, for example, easily integrate and use sensor data to allow new operational features.

CHAPTER 2

LITERATURE SURVEY

REVEALING PEDESTRIAN BEHAVIORS TO SUPPORT THE DECISION-MAKING OF AUTONOMOUS VEHICLES:

Prior to the widespread use of autonomous vehicles, it is important to show passenger intentions and behaviour patterns; in a conflict situation, the vehicle would come up with the conclusions drawn in response to the appropriate response. This paper focuses on the areas where cars and football collide. The aim was to devise a method of preventing autonomous vehicles from colliding with pedestrians. Typical pedestrian movements were determined through an on-site assessment and a questionnaire survey. Furthermore, the meaning has a major impact on the movements around a crossing (e.g., location of public transportation stop). Furthermore, gender has a significant influence on crossing behaviour. The findings support the prediction of a pedestrian's position, which can be used to develop applications for self-driving cars.

VISION-BASED RECOGNITION OF PEDESTRIAN CROSSING INTENTION IN AN URBAN ENVIRONMENT:

The behaviour of pedesters must be recognised by autonomous moving platforms in order for them to perform better (like self-driving cars or mobile robots). Recognizing pedestrians' intent to cross is one of the most critical self-driving capabilities in an urban environment for ensuring safe operation. Some researchers characterise pedestrians' intentions to cross based on their routes, ignoring the informative appearance. The function of pedestrians is shown in two visions in this

thesis. To detect eye contact between foot and motorcycle trains, a classifier that looks or does not look is built. These eye contacts are thought to be inextricably linked to pedestrians' desire to cross. Until pedestrians begin to cross, a passageway or non-crossing designation is used to take early action, such as limb movements. Because of the limited training samples, data increase is applied to both classifiers prior to training. In the meantime, the focal failure has been programmed into the two classifiers to help with the issue of easy or complicated samples. The effectiveness of the visual indicators indicated in recognising the intention to cross pedestrians is tested in experiments. The two classifiers outperform the proposed techniques in the training as compared to the baseline.

AUTOMATED, LOW-COST PEDESTRIAN CROSSING CARRIAGE FOR EFFICIENT TRAFFIC CONTROL AND PEDESTRIAN SAFETY:

Huge traffic delays have resulted from unorganised urban growth and a significant rise in the use of road cars in the world's cities. Unfortunately, the pedestrian crossing that was designed to make it easier for pedestrians to cross the roads has now become a traffic hazard. Despite the implementation of intelligent zebra lines, there has been no reduction in the amount of time spent waiting in vehicle lines. Furthermore, because of their costs in the local sense, the construction of transit centres and subway crossings has remained quiet. Several pedestrian crossing systems are available, but they are not secure or suitable for handicapped people, elderly, infants, or the sick. Despite the fact that traffic control is inefficient, a large number of police officers are required to spend time on it. Some studies focused on autonomous vehicles and robotics as tools for reducing traffic congestion. This paper focuses on the creation of an automated guided transportation system for pedestrian travel in an efficient and secure manner.

PEDESTRIAN PRESENCE DETECTION SYSTEM BASED ON IMAGE PROCESSING:

Pedestrian detection and tracking systems typically use intelligent video surveillance, smart transportation, car self-driving, or driving assistance systems. For developing pedestrian screening, tracking, counting, and video warning, we chose Open CV as the process. We use a low-dimensional soft-output SVM football classifier to ensure accurate pedestrian identification. Experiments show that the system has a high level of recognition accuracy and can operate in real time. The architecture is based on the Visual Studio 2010 platform. For the implementation of foot detection, tracking, counting, and danger alerting in one video portion, we chose OpenCV as the development tool, and we enhanced several functions with it. The unit block diagram has five modules. The user interface is used to load and play video as well as display system functionality. The foreground objects are differentiated with the aid of the backdrop. From the foreground objects, pedestrian features and the small-dimensional soft-output SVM Football Classifier are scanned. Finally, passengers who are interested are plotted on their routes.

PREDICTING PEDESTRIAN ROAD-CROSSING ASSERTIVENESS FOR AUTONOMOUS VEHICLE CONTROL:

Like pedestrians, autonomous vehicles must interact with other road users. Pedestrians, in contrast to passive environments, have their own services and choices that AVs must make in order to monitor their interactions and manoeuvre around them. In particular, if a pedestrian wishes to cross the road at an unmarked crossing in front of a vehicle, he or she must compete for space with the AV, which can be

viewed as a game theoretical interaction in which one agent must yield to the next. This study collects and analyses data from real-world human road crossings in order to train AV controllers in this environment and assess what features of traverse behaviour are predictive of pedestrian assertiveness and the eventual winner of interactions. It contains the largest and most detailed data set of its kind that we are aware of, as well as novel methods for analysing and forecasting pedestrian-vehicle interactions. The paths and vehicles' relationships are decomposed into distinct sequences of discrete events. To classify common behavioural trends and predict which interaction winner, we use probabilistic methods — logistic regression and decision tree regression — and sequence analysis to look at sets and sub-sequences of behaviours used by both pedestrians and human drivers during cross-sections. We report on the more predictive features that can be built into theoretical AV game controllers to inform real-time interaction.

CHAPTER 3

MATERIALS AND METHODS

3.1 EXISTING SYSTEM:

- In existing system, they used beacons or LiDAR to detect the pedestrians.
- They use some LiDAR based algorithm for detect and analyses the pedestrians.
- LiDAR detection is having problem with accuracy and the algorithm-based approaches are problematic in real time applications.

3.1.1 DISADVANTAGES OF EXISTING SYSTEM:

- LiDAR based detection have accuracy issues.
- In real time monitoring, algorithm analysis has some errors, so it leads to wrong signaling.

3.2 PROPOSED SYSTEM:

- In proposed system, we use IR sensors for human detecting near the signal pole, so the detection is takes place in real time.
- By using ZigBee communication, the two side poles are working in accordance with another.

3.2.1 ADVANTAGES OF PROPOSED SYSTEM:

- Accuracy is high.
- Less expensive, low power consumption and easy time install and maintain.

3.2.2 BLOCK DIAGRAM OF PROPOSED SYSTEM TRANSMITTER SIDE:

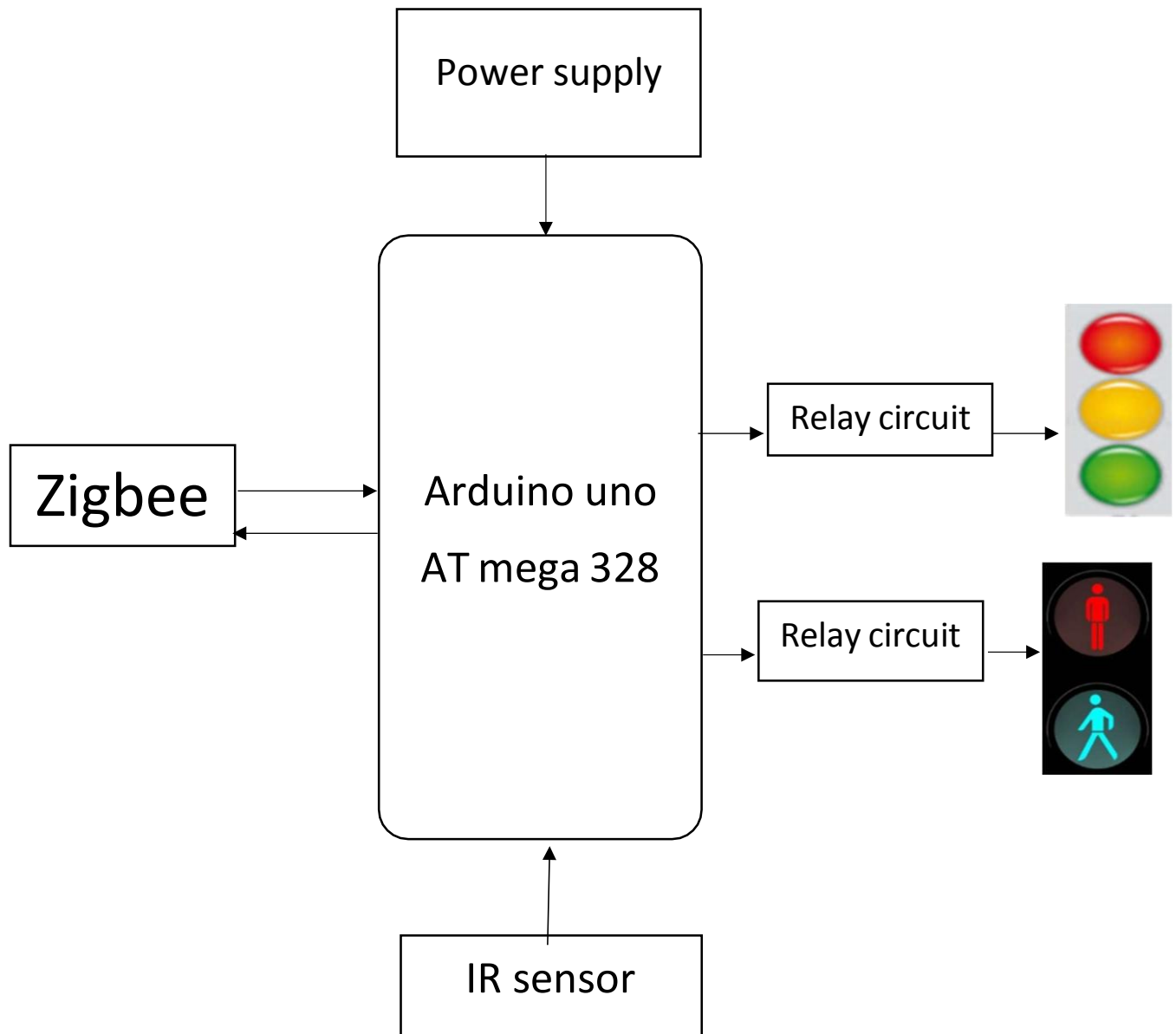


Fig 3.1 Block Diagram of Proposed System Transmitter side

3.2.3 BLOCK DIAGRAM OF PROPOSED SYSTEM RECEIVER SIDE:

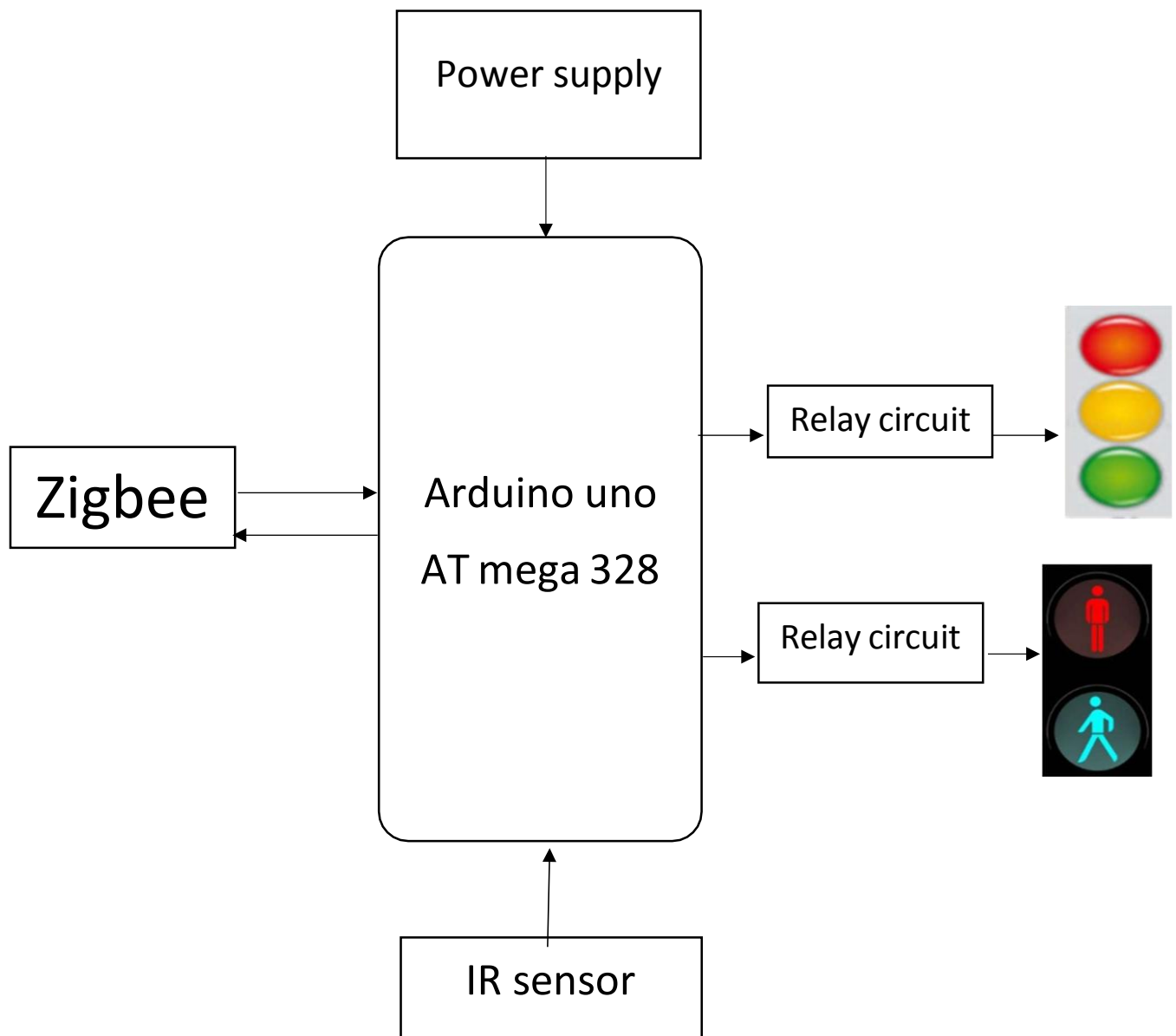


Fig 3.2 Block Diagram of Proposed System Receiver Side

3.2.4 DESCRIPTION OF BLOCK DIAGRAM: -

Order, ZigBee, IR sensor, and relay circuits can be used to link the Arduino Uno to the transmitter and receiver sides. When a pedestrian approaches an IR sensor on the Transmission or Receiver, he transmits a signal to ZigBee via Arduino UNO, and ZigBee facilitates wireless contact between traffic signals and the Red via a relay circuit. After the pedestrian has passed through the signal, the traffic light signal is turned green for cars.

HARDWARE REQUIREMENTS:

- Arduino UNO,
- IR sensor,
- Zigbee module,
- Relay circuit,
- LED,
- Power supply.

SOFTWARE REQUIREMENTS:

- Arduino IDE,
- Embedded c.

3.3 HARDWARE DESCRIPTION

3.3.1 ARDUINO UNO:

To begin with, the UNO is the best board for electronics and coding. If this is your first time tinkering with platforms, the UNO is the most stable board to start with. In the Arduino family, the UNO is the most commonly used and recognised committee.

The Arduino Uno is a microcontroller board based on the ATmega328P. (datasheet). It has fourteen digital input-output pins (six of which are for PWM outputs), six analogue inputs, a 16 MHz quartz crystal, a USB connection, an ICSP header, and a reset button.

It comes with all the microcontroller requires to get started; simply connect it to a USB port or power it with an AC-to-DC adapter or battery.

There are several different Arduino boards on the market, including the Arduino Uno, Arduino Due, Arduino Leonardo, and Arduino Mega, though the Arduino Uno and Arduino Mega are the most common. If the project is for digital electronics, embedded systems, robots, or IoT, the simplest, fastest, and cheapest choice is to use an Arduino Uno.



Fig 3.3 Arduino UNO

3.3.2 ARDUINO BOARD

Several kinds of Arduino boards are available, many of which are compatible with third parties. The Arduino Uno R3 and Arduino Nano V3 are the most common versions. Both run a 16MHz Atmel Microcontroller ATmega328P 8-bit RAM flash with 14 digital I/Os and six analog I/Os, and it won't sound 32KB like it runs Windows. Arduino projects may be autonomous or communicate on a mobile device with applications. Flash and Max/MSP, for example). For instance. On the board are a 16 MHz ceramic resonator and a USB power and link. Micro-SD or SD card storage can be easily added to larger tasks.

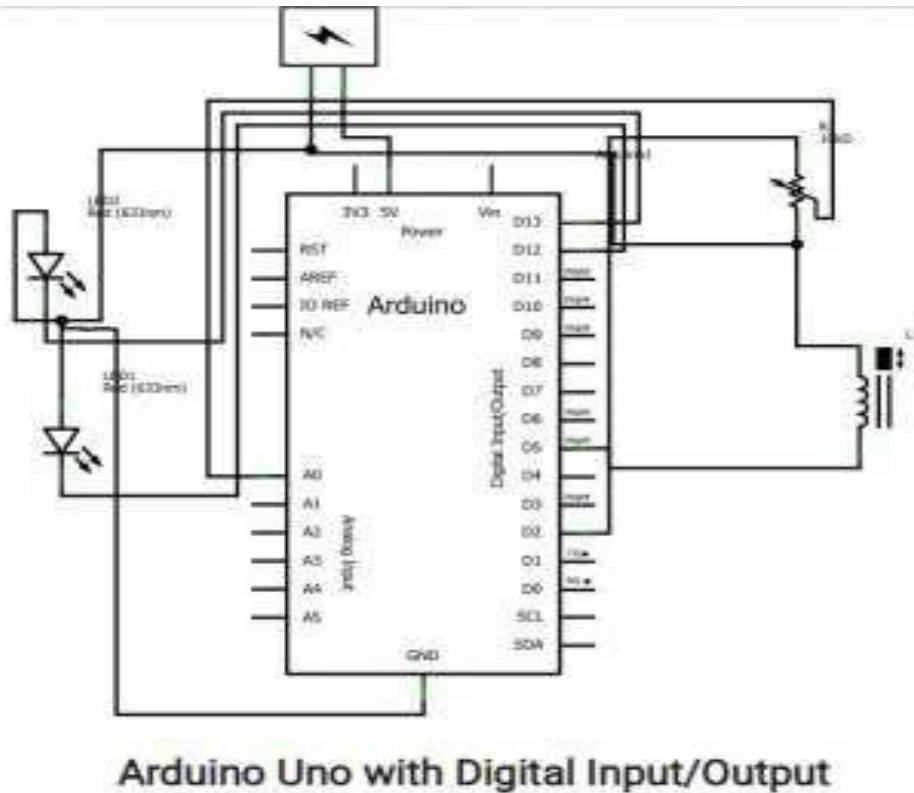


Fig 3.4 Arduino Uno with Digital Input/Output

3.3.3 FEATURES OF ARDUINO:

- It is an easy USB interface. This allows interface with USB as this is like serial device.
- The chip on the board plugs straight into your USB port and supports on your computer as a virtual serial port. The benefit of this setup it is that serial communication is extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.
- It is easy-to-find the microcontroller brain with the ATmega328 chip. It has a greater number of hardware features like timers, external and the internal interrupts, PWM pins and multiple sleep modes.

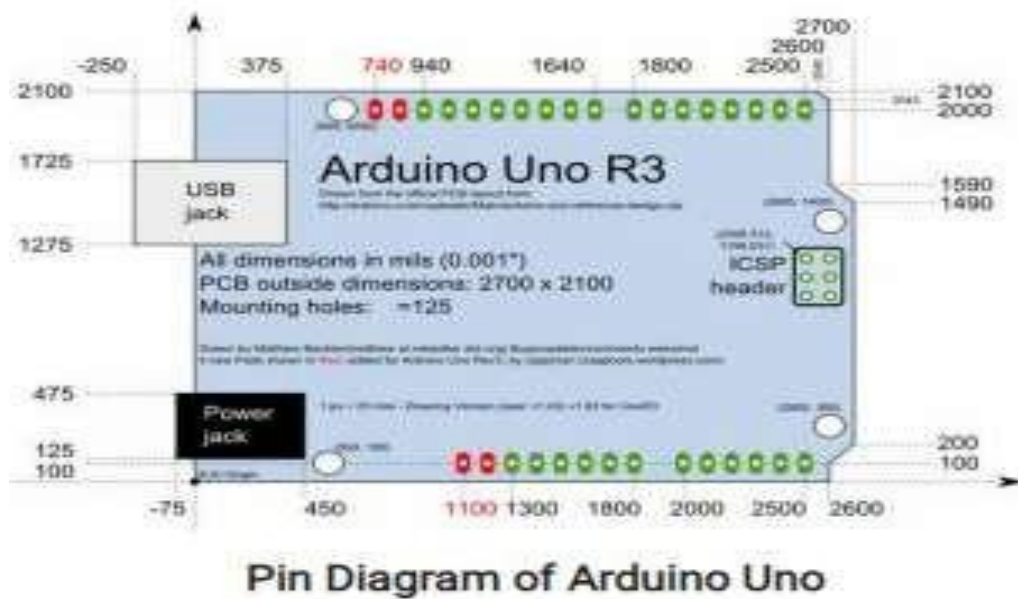


Fig 3.5 Pin Diagram Of Arduino Uno

You can then use Atmel's FLIP software (Windows) or the DFU programmer (Mac OS X and Linux) to load new firmware.

3.4 IR SENSOR:

An electronic system is a sensor that emits infrared light to sense certain aspects of the environment. An infrared sensor can detect movement and measure the object's heat. A passive infrared sensor is one that only measures infrared radiation rather than emitting it. In the normal course of things, everything emits thermal radiation in the infrared spectrum. The infrared sensor can detect radiation forms that are invisible to the naked eye. It's just an infrared LED, and the detector is just an infrared photodiode that detects infrared light of the same wavelength as the IR LED.

The resistors and output voltages conform to the size of the obtained IR light as photodiode IR light.

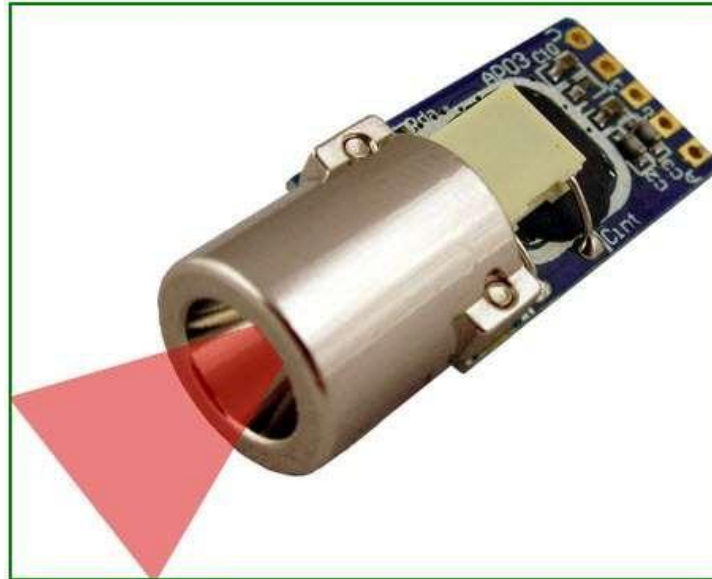


Fig 3.6 IR Sensor

3.4.1 IR Sensor Circuit Diagram and Working Principle: -

One of the most common sensor modules in the electronic device is an infrared sensor circuit. This sensor is similar to the visionary senses of humans that can be used for the detection of obstacles. The following components are part of this circuit

- LM385 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo ohms.
- Variable resistors.
- LED (Light Emitting Diode).

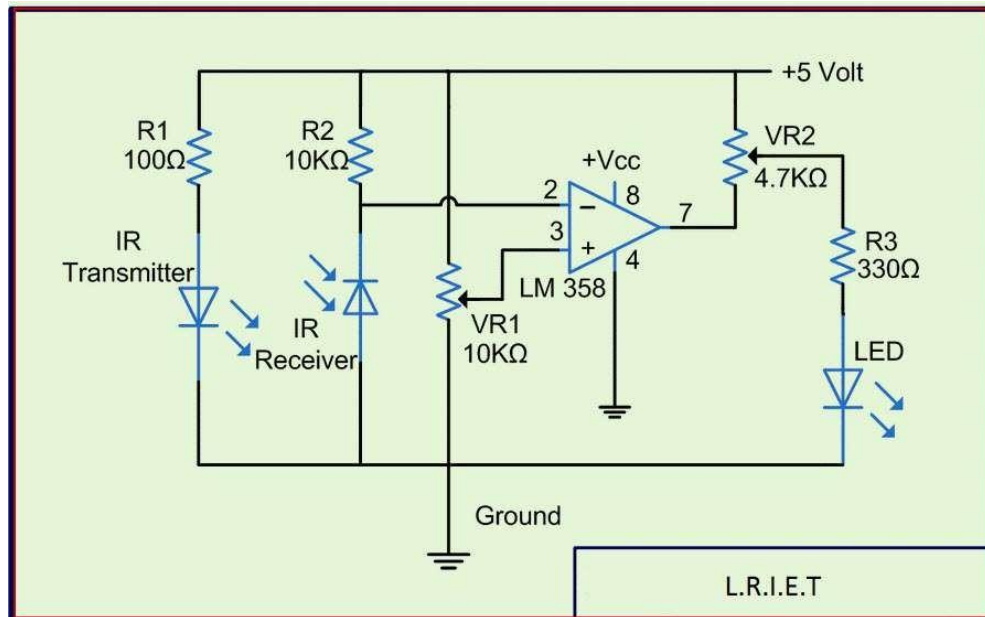


Fig 3.7 Circuit Diagram of IR Sensor

In this project, the transmitter consists of an IR sensor that sends continuous IR light to the IR receiver module. Depending on whether IR rays are emitted, the receiver has an IR output terminal. This output can also be fed into the comparator circuit because this disparity cannot be analysed separately. With the LM 339 operational amplifier (op-amp), a computer circuit is used.

The inversion input potential of the IR receiver is greater than the inverted input potential of the comparator IC if the IR receiver does not receive a signal (LM339). As a result, the comparator output is very small, but the LED does not light up. If the IR reception module receives a signal, the chances of reverting input are slim. The efficiency of the comparator (LM 339) is then high, and the LED begins to glow. The resistors R1 (100) and R2 (10k) and R3 (330) are used to ensure that minimum 10 mA current passes through IR LEDs such as Photodiode and regular LEDs. For the output terminals adjustment, the resistor VR2 (preset=5k) is used. To set

sensitivity on the circuit diagram, Resistor VR1 (preset=10k) is used. Read all about infrared sensors.

3.4.2 Different Types of IR Sensors:

IR sensors are divided into many categories based on their intended use. Some of the most common uses for different sensor types include:

The velocity sensor is used to synchronise the speeds of several engines. The temperature sensor is used in industrial temperature control. PIR is used for automatic door opening, and an ultrasonic sensor is used for distance measurement.

3.4.3 IR Sensor Applications

In many sensor-based projects, IR sensors are often used in different electronic devices that calculate the temperature discussed below.

Thermometers of radiation

In radiation thermometers, IR sensors are used for measuring the temperature dependent on the temperature and material of the object.

Measurement without direct contact with the object

- Faster response
- Easy pattern measurements

3.4.4 Flame Monitors

The light emitted by flames is used to detect and monitor them with this form of equipment. The light emitted by the fire is classified as UV, UVA, UVB, PbS, PbSe is a two-color sensor that is widely used in flame monitor applications.

3.4.5 Moisture Analyzers

Moisture-absorbing wavelengths in the infrared range are used by humidity analyzers. Light shall be irradiated on objects with these wavelengths (1.1 μ m, 1.4 μ m, 1.9 μ m, and 2.7 μ m) and reference wavelengths. The moisture analyzer measures the reflected lights of the artefacts, which are moisture dependent (ratio of reflected light at these wavelengths to the reflected light at reference wavelength). Humidity analyzers in GaAs PIN photodiodes use PbS photoconducting detectors.

3.4.6 Gas Analyzers

IR sensors are used in gas analyzers that use the absorption properties of gases in IR areas. There are two methods for measuring dispersive and non-dispersive gas density.



Fig 3.8 Gas Analyzer

Dispersive: To assess gas ingredients and sample quantity with absorption characteristics, a spectroscope divides an emitted light.

Non-dispersive: the most popular solution, which relies on absorption properties rather than the division of emitted light. Discreet band pass filters are used in the same way as sunglasses are used to block unwanted UV radiation by using non-scattering forms.

This form of configuration is known as non-dispersive infrastructure technology (NDIR). In most commercial IR instruments, this type of analyzer is used for carbonated drinks, while non-scatter analyzers are used for car-fuel exhaust gas leaks.

3.4.7 IR Imaging Devices

The IR image system is one of the most popular IR wave applications, owing to its invisibility. It's used for thermal imaging, night vision, among other stuff.

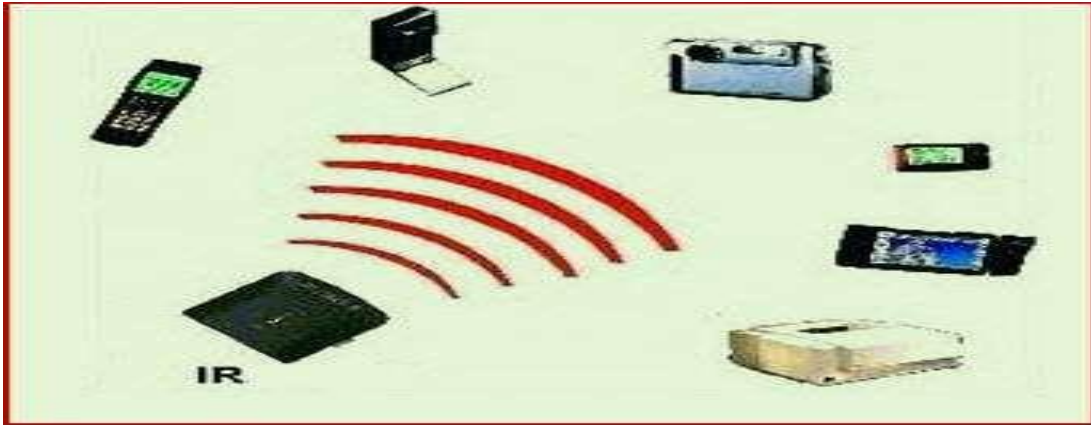


Fig 3.9 IR Imaging Devices

Water, rocks, soil, plants, the atmosphere, and human tissue, for example, all emit infrared radiation. The thermal infrared detectors calculate these radiations in the infrared spectrum, and the image displays the spatial temperature distributions of the object and position. Thermal image-forming substances include Sb (indium antimonite), Gd Hg (mercury-doped germanium), and Hg Cd Te (mercury-cadmium-tellurides).

Low temperatures are achieved by cooling an electronic sensor in liquid helium or liquid nitrogen. Then there's the issue to deal with. The radiant energy (photons) collected by the sensor is from the ground, not from a radiant electronic device for IR imaging from the ambient temperature of objects within the scanner.

This is also about the IR sensor circuit's operation and system. These sensors are used in a variety of electronic sensor-based projects.

3.5 ZIGBEE:

In line with other wireless personal area networks (WPANs), such as Bluetooth or wireless networks, the Zigbee specification outlines technology that is meant to be easier and less expensive. Wireless lighting switches, home energy management systems, road traffic control systems, and other industrial and consumer equipment that needs a short-range wireless data transfer are among the items covered.



Fig 3.10 Zigbee

Because of its low power consumption, transmission distances are limited to between 10 and 100 metres, depending on power output and environmental factors.

Over long distances, Zigbee devices can relay data from a mesh network of intermediate devices to more distant ones.

Zigbee is widely used in battery life and efficient networking applications (Zigbee networks are secured by 128 bits symmetric encryption keys.) Zigbee offers a fixed

rate of 250 kbit/s, making it suitable for regularly occurring sensor or input transmissions.

3.5.1 ZIGBEE MODEM



Fig 3.11 Zigbee Modem

In 1998, Zigbee was developed, standardised in 2003, and modified in 2006. The name comes from the wagging dance that honey bees do when they return to the hive.



Fig 3.12 Zigbee Architecture

The Zigbee system is made up of three different computer types: Zigbee, Router, and End. Any Zigbee network must have at least one coordinator, who serves as the network's root and bridge.

The coordinator is in charge of managing and storing data during receiving and transmitting data type operations. Zigbee routers act as middlemen, allowing data to be sent from one computer to another via TO and FRO. End devices have only the most basic capabilities, such as saving battery power with the parent nodes. The number of routers, coordinators, and terminals varies depending on the network type, such as star, tree, or mesh.

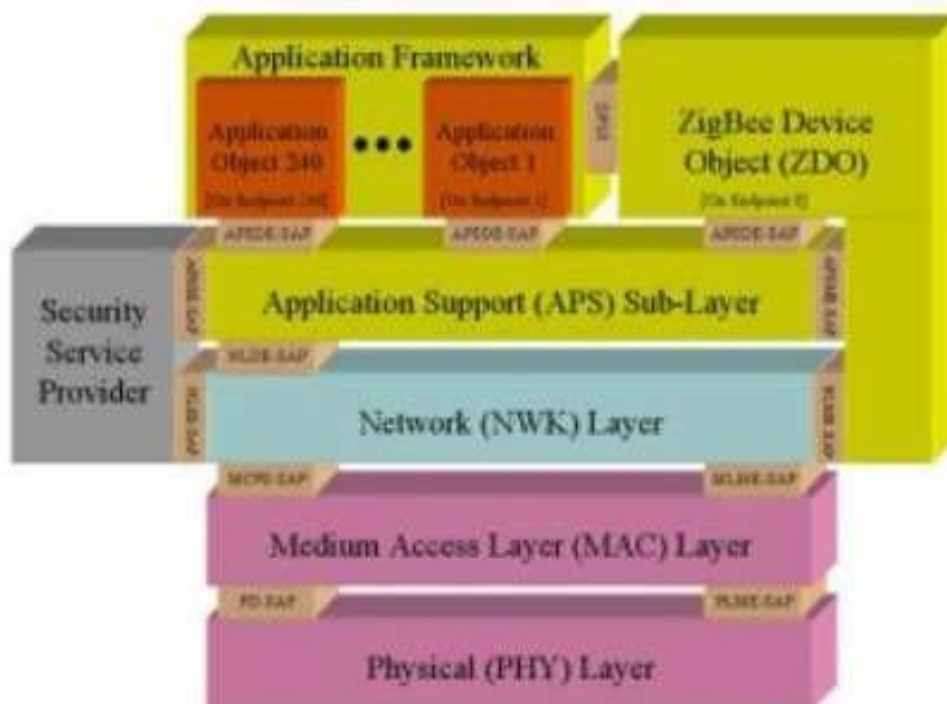


Fig 3.13 Zigbee Protocol Architecture

The Zigbee protocol's architecture is made up of a multi-layer stack that specifies the physical and MAC layers in IEEE 802.15.4, with the Zigbee networking and system layers completing the protocol.

3.5.2 Physical Layer of ZigBee:

Once the signals are sent and received, this layer modulates and demodulates. This layer's frequency, data rate and number of the channels are given below.

	BAND	COVERAGE	DATA RATE	CHANNEL NUMBERS
2.4 GHz	ISM	Worldwide	250 kbps	11-26
868 MHz		Europe	20 kbps	0
915 MHz	ISM	Americas	40 kbps	1-10

Fig 3.14 Physical Layer of Zigbee Protocol

3.5.3 MAC Layer:

In the context of a carrier, this layer is responsible for efficient data transmission by accessing multiple access collision avoidance networks (CSMA). The synchronisation beacon frames are also passed on.

3.5.4 Network Layer:

This layer is designed to handle all network-related operations, such as set-up and network connection, routing, system settings, etc.

3.5.5 Application Support Sub-Layer:

This layer allows services to be interfaced with network layers to serve Zigbee system objects and applications objects. The two devices according to their services and needs are responsible for this layer.

3.5.6 Application Framework:

It provides two types of data services as an essential value pair and generic message services. The developer specifies the structure of the generic message, and key value

pairs are used to extract attributes from the application objects. Between the framework artefacts and the APS layer in Zigbee devices, ZDO provides an interface. Other devices are detected, initiated, and connected to the network.

USES:

Zigbee protocols are designed for low-power, low-data-tolerance embedded applications. The resulting network would consume very little electricity, with individual devices having a battery life of at least two years, as required by Zigbee certification.

Typical application areas include:

- Home automation
- Wireless sensor networks
- Industrial control systems
- Embedded sensing
- Medical data collection
- Smoke and intruder warning
- Building automation

Remote wireless microphone configuration

3.5.7 Mesh networking topology in ZigBee

In ZigBee, networking networks are used. Messages can be sent from any source to any destination. Each fixed function device can act as a router for its neighbours. The network spectrum is broadened by using a multi-hop topology. The use of multiple paths resulted in a high level of reliability.

ZigBee was developed to use the topology of mesh networking. The mesh network allows any device or node in the network to communicate with each other.

In practise, every machine acts as a router, which increases network efficiency. To begin routing, each device can have different functions, such as configuring the communication path and connecting to other active equipment.

Device to device communication:

The infrastructure used by modern wireless technologies such as the Internet of Things and 5G is an app for interacting with a smartphone. Without a central transceiver node, devices can communicate with one another in D2D communication.

In smart home applications, ZigBee can communicate from device to device using a mesh network topology. Via D2D communication, devices can locate another active device in their vicinity, begin communication without interruption, and increase machine performance.

3.5.8 Specification of ZigBee

Standard	:	IEEE 802.15.4
Frequency	:	2.4 GHz (home automation), 784 MHz, 868 MHz and 915 MHz (country specific)
Range	:	10 to 100 meters (line of sight)
Data Rate	:	20 kbps to 250 kbps
Network type	:	Mesh networking and device to device communication

3.5.9 Advantages of ZigBee:

- Low-cost solutions
- Low power consumption
- Highly efficient due to long battery life
- Simple installation and implementation
- Scalable network, support larger number of devices
- Remote monitoring and control of devices
- Highly reliable network
- Wireless coexistence with other technologies

3.5.10 Disadvantages of ZigBee:

- Short range communication
- Low data rate transmission
- Security vulnerability due to personal information collected in devices

3.5.11 Applications of ZigBee:

- Smart home applications
- Security monitoring and controlling home applications from remote locations
- ZigBee enabled remote controls which doesn't require line of sight for controlling, it offers greater convenience
- Automatic doors, windows enabled with motion sensors
- Smoke, water and gas leak sensors which alerts

3.6 LED:

A Light Emitting Diode (LED) is a semiconductor light source that emits light as current passes through it. Electrons in semiconductors recombine with electron holes and release energy in the form of photons. Electroluminescence is the name given to this phenomenon. The colour of light is determined by the energy required for electrons to cross the semiconductor band gap (corresponding to Photon energy). Blue light is generated using a multi-semiconductor or light-emitting phosphorus layer on the semiconductive unit.

The first infrared LEDs appear as functional electronic components in 1962. Remote control devices use infrared LEDs, which can be used in a variety of consumer electronics. Red was the only colour available for the first low-intensity visible LEDs. Via visible wavelengths, modern ultraviolet and infrared LEDs with high light intensity are available.

Early LEDs were also used as indicator lamps and as a replacement for small light bulbs and seven-segment displays. Recent technological advancements have resulted in the development of white-light LEDs suitable for room lighting. LEDs have created new displays and sensors, despite their high speeds being useful in advanced communication technology.

Low energy consumption, a long life span, improved physical strength, smaller sizes, and quicker switching are just a few of the advantages of incandescent light sources. Light-emitting diodes are also used in applications such as aviation, vehicle headlamps, publicity, general lighting, traffic signals, camera bursts, light wallpapers, and medical equipment.

The light colour emitted by an LED, unlike that of a laser, is not consistent or monochromatic, but the spectrum is narrow and functionally monochromatic in terms of human vision.

3.6.1 TYPES OF LED

LEDs come in a variety of bundles depending on the application. In one thumbnail, one or more LED junctions may be packed as an indicator or a pilot lamp. An LED array can include control circuits that range from a simple, blinking, changing colour control to an RGB addressable controller, all of which are contained within the same box. On heat sinks, higher-wattage white-emitting units are mounted and used for lighting. Dot matrix and bar displays are both popular formats for alphanumeric displays. Special packages enable LEDs to be connected to optical fibres for high-speed data communication links.

3.6.2 LED MINIATURE

LEDs are usually single die with dimensions ranging from 2 to 8mm, holes, and surface mount packages. The majority of these LEDs are single die. The current rates range from around 1 mA to more than 20 mA. Several LED dies are linked to a versatile backbone form of LED strip light.

Round, dome, or flat top, flat top rectangular (as in bar-graph displays), or triangular or square top flat are all common package shapes. To improve contrast and angle of view, the encapsulation may be translucent or tinted. When infrared radiation is passed, infrared instruments may be black to block light.

LEDs with ultra-high output for viewing in direct sunlight

Common mini-LEDs with series resistance for direct 5-V or 12-V connections are 5-V and 12-V LEDs.

3.6.3 HIGH POWER LED:

At currents from hundreds of milliamperes to more than an ampere, high-power LEDs or high-output LEDs (HO-LEDs) can be monitored, compared with tens of billiamperes for other LEDs. A thousand lumens are likely to be published. LED power densities were achieved up to 300 W/cm². The HP-LED must be installed on a heat sink in order to allow heat dissipation, because overheating is harmful. The system will fail in a flash if the heat from an HP-LED is not removed. A HP-LED can be used to change an incandescent bulb to a flashlight or to set up an efficient LED lamp in an array.

3.6.4 AC DRIVEN LED:

On AC power, Seoul Semiconducteur shaped LEDs can be used without a DC converter. For each half-cycle, the LED part emits light, and the part is dark, which is reversed for the next half-cycle. For this HP-LED, the efficiency is usually 40 lm/W. Many LED elements in series can work directly from the line voltage. Seoul Semiconductor released the 'Acrich MJT,' a high voltage DC LED that could be operated by a simple circuit from AC power, in 2009. These LEDs are less efficient and more versatile than the original AC LED style.

3.6.4 Application-specific variations:

Flashing: -

Without the use of external circuitry, flashing LEDs are used to search for signals. An integral Multi-vibrator circuit in Blitz-like LEDs causes the LED to blow up during a standard one-second period. In diffused lens LEDs, this circuit appears as a small black dot. Most blinking LEDs emit a single colour light, but more advanced devices can switch between multiple colours and even fade via an RGB colour series.

Bi-color: -

In the case of a bi-color LED, there are two different LED emitters. There are two types of these. One type consists of two dies that are connected to the same two dies in antiparallel directions. In one direction, the current emits one colour, and in the opposite direction, the current emits the other colour. The other type has two dies for each die and a separate lead for the typical anode or cathode, allowing them to be operated independently. The amber and/or traditional green, the red or pure green, the red or blue, and the pure blue or green are some of the other options.

RGB Tri-color: -

In one case, three different LEDs produce three different emitters. Each transmitter has a separate lead connection so they can be automatically monitored. Typical with one single lead (anode or cathode) is a four-lead structure and an extra lead for each colour. But some have only two leads (positive and negative) and an electronic control system integrated.



Fig 3.15 RGB tri color

RGB LEDs are made up of three colours: red, green, and blue. RGB LEDs can provide a wide variety of colours by adjusting each of the three separately. In contrast to dedicated-color LEDs, these do not contain pure wavelengths. Modules cannot be optimised for seamless colour mixing.

Decorative-multicolor: -

Just two lead-out wires with multifunctional colour transmitters are used in decorative multicolor LEDs. Colors are switched internally by adjusting the supply voltage.

Alpha Numeric:

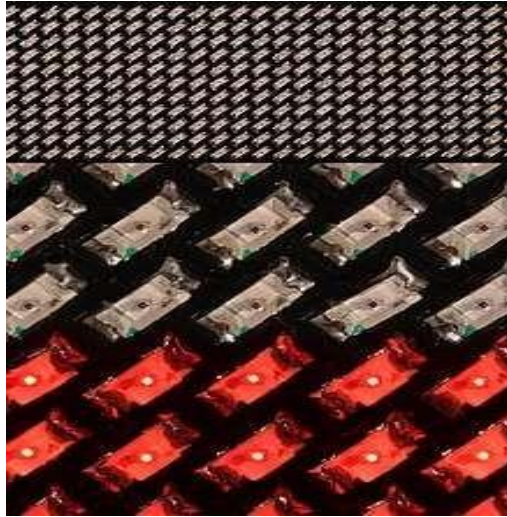


Fig 3.16 Alpha numeric

There are seven-section, starburst, and dot-matrice numeric LEDs to choose from. Seven-segment displays can accommodate both numbers and a limited set of letters. On Starburst screens, all letters are visible. Normally, dot-matrix displays are used.

Use 5x7 pixels per character. With their lower power and greater display flexibility, the popularity of numeric and alphanumeric LED displays was reduced when used widely in seven segments of the LED display market.

Digital RGB:

Intelligent electronic controls are built into digital RGB LEDs. These provide energy and ground in order to link the data-in, data-out, and sometimes a clock or strobe signal. The daisy chain is used to bind them. Data sent to the chain's first LED will monitor the luminosity and colour of each LED independent of others. They're used when a combination of full control and minimally visible electronics, such as Christmas strings and LED matrices, is needed. Some of them also have kHz refresh rates, allowing for easy video applications. These devices are identified by their part number (WS2812 is common) or by their brand name, such as neo pixel.

Filament: -

A LED filament is made up of a series of LED chips that are connected to a regular longitudinal substratum to form a thin rod that looks like a light filament. Many countries use this as a low-cost decorative alternative to traditional light bulbs. The filaments run at a very high voltage and can easily work with mains voltages. Without the complexity of a high current low-voltage converter, which is required for single die-LEDs, a simple rectifier and power limitation is frequently used to create an inexpensive replacement for a standard light bulb. They're usually wrapped in bulbs that look like the lamps they're supposed to replace, and they're filled with inert gas to keep the heat out.

Chip-on-board arrays: -

Surface-mounted LEDs are often made in a board chip (COB) series, which allows for more efficient heat dissipation than a single light output LED. The yellow LEDs can be mounted in a cylinder and labelled "corn cob lights" due to their ranks.

3.7 SOFTWARE REQUIREMENTS:

3.7.1 Arduino UNO

The Arduino Uno can be programmed with the software Arduino (download). From the drop-down menu select "Hardware Uno > Board Menu" (according to the microcontroller on your board). The ATmega328 bootloader is pre-burned and allows the use of a different hardware programmer for uploading new code. The STK500 protocol is used for communicating (reference, C header files). You may also disable a bootloader and program the microcontroller via the ICSP header. For information, see this directive. The source code of ATmega16U2 is given (or 8U2 for rev1 and rev2 boards). The ATmega16U2/8U2 can be enabled through a DFU bootloader:

- The solder jumper is connected to the back of the board (near the map of Italy) on Rev1 boards, and then the 8U2 is reset.

A resistor can be used in the DFU mode on Rev2 or later boards to pull the HWB 8U2/16U2 row to ground. The Atmel FLIP software (Windows) or the Mac OS X and Linux DFU programmer will then be used to load new firmware. Alternatively, you can use an external programmer with the ISP header (overwriting the DFU bootloader). Computer resetting is done automatically. Rather than getting a physical reset button, the Arduino Uno is programmed to reset the software running on a linked computer before an upload.

A 100 nano-farad condenser connects one of the ATmega8U2/16U2 hardware flow control lines (DTR) to the ATmega328 reset grid. When claimed, the line reset is long enough to reset the chip (taken low). The Arduino programme uses this feature to upload code by simply pressing the Arduino Upload button. Since DTR reduction can be synchronised well with the start of the loading, the bootloader can have a shorter timeout.

There are various effects in this setup. If Uno is connected to a Mac OS X or Linux system, it resets when a software connection is established to the device (via USB). The bootloader can run on the Uno for around half a second. Though malformed data (all but uploading a newer code) will be ignored, after the link is open it will intercept the first few bytes of data sent to the table. If a board diagram is first produced or other data is first started, make sure you communicate with the software for one second after you open the link and prior to uploading the data. The Uno trace can be cut to disable the automatic reset. The pads can be soldered to re-enable on both sides of the track. There is a number in the word "RESET-EN." By attaching the reset line to a 5V 110 ohms resistance, you can also disable the automotive reset.

3.7.2 EMBEDDED C:

Embedded C Programming is the soul of any embedded device that works inside the processor, such as the computer, laundry machine and digital camera. We are experiencing everyday life.

The embedded software is linked to each processor. The only factor that determines how an embedded system works is the embedded software. The most common language to programme microcontrollers is the Embedded C language.

Many embedded systems have previously been designed using the programming of assembly levels. They did not provide portability, however. The introduction of many high-level languages such as C, Pascal and COBOL has resolved this drawback. However, and this is still so, it was the C language which has been widely accepted by embedded systems. The written C code is more stable, flexible and portable, and is actually much more comprehensible.

In 1969, Dennis Ritchie invented C language. It is a set of one or more functions, and each function is a group of statements which perform a particular task.

C language embraces high level software and low-level applications, which is a medium-level language. We should know about the RAM memory organisation before getting into the specifics of embedded C programming.

Salient language characteristics

- The language is a programme that uses various keywords, types of data, variables, constants and so on.
- Embedded C is a generic term for a language of programming written in C associated with a specific architecture of hardware.
- Embedded C is a C language extension with some extra header data. These header files can be modified to the controller.
- The 8051 `#include<reg51.h>` microcontroller is in use.

The embedded device designers need to know the hardware architecture for software writing. These programmes play a major role in external system surveillance and control. The internal microcontroller architecture such as interrupt management, timers, serial communication and other features are also used and operated directly.

3.7.3 The basic additional features of the embedded software:

Data types: -

A broad platform for declaring variables in a variety of formats, including integer, character, and float. This is what the data form applies to. In the integrated C programme, four different types of data are used to store data in memory.

The char value is used to store a single character; the integer value is stored by the 'int' value; and the float value is used to accumulate any precision point value floating.

On a 32-bit machine, the dimensions and range of different data types are shown in the table below. The size and range of words on machines with different word sizes will vary.

Keywords: -

There are some words reserved for the particular tasks. These terms are referred to as keywords. The Embedded C are default and predefined.

Keywords are usually written in lower case. Before writing the main program, these keywords must be specified. Following are the basic keywords of an integrated software:

Tab 3.1 keywords

Name	Funtion
sbit	Accessing of single bit
bit	Accessing of bit addressable memory of RAM
sfr	Accessing of sfr register by another name

SFR Register:

The SFR is the 'Special Register of Functions.' There are 256 bytes of RAM memory available in Microcontrol 8051. The first part of 128 bytes is used for data storage and the remaining 128 bytes are used for SFR logs. This is the RAM split into two parts. The SFR Register contains all of the peripheral devices such as I/O ports, timers and counters, and each part has a unique address.

3.7.4 The Structure of an Embedded C Program

- comments
 - preprocessor directives
 - global variables
 - main () function
- {
-
- local variables
 - statements

-
-
- }
- fun (1)
- {
- local variables
- statements
-
-

CHAPTER 4

RESULTS AND DISCUSSIONS

Figure 4.1 depicts the final assembly of our automated testing system. The entire testbed is made up of two fully functional stand-alone light units, one of which is used by both vehicles and people at the same time. Every device will be installed on one side of the footbridge. With automatic pedestal detection and wireless traffic light control, the Bluetooth is completely enabled. The Zigbee module uses

the 2,4 GHz frequency band to communicate with the other component (maximum range is 10 m). The AC unit has an infrared sensor that senses the presence of another unit of the peaton at the roadside and shares data with it. One of the issues we're dealing with is the IR sensor's radius of range detection. It has a minimum range of 2.5 m up to 8 m motion detection, depending on the sensitivity, delay, and ambient temperature. As a result of the fact that a feeder can be detected from a distance away from the traffic light, the IR sensor will give the incorrect signal. The susceptibility and time of delay were checked during a sensor calibration test, as well as the normal (NO) and reduced (RS) IR sensitivity tests. The effect of the ambient temperature sensor detection range on the sensor detection range was evaluated. Since the sensor is an integral part of our system, it was tested both during the day and at night to understand its expected behaviour. In the m detection range, the effect of the temperature surrounding the IR. As the temperature rose, the detection range for both sensitivity determination: normal behaviour and reduced responsiveness shrank. The larger the detection range, the higher the air temperature. At high temperatures, we were able to reduce the sensor's sensitivity to a range of 2,5 m. However, because of the sensor's long range, it can make a mistake if it detects a distant footbridge. To overcome this problem and reduce the detection range to less than 2 m, a PVC tube is used to restrict the sensors detection angle, and an IR sensor is set at 2.5 m (45 degrees angle to the ground). The detection angle was reduced by putting the IR sensor within a hole. IRs provide information about the presence of people in their detection ranges to local and remote microcontrollers. It was installed on a zebra crossing on the Malaysia Pahang University campus to demonstrate its functionality in a real-world setting (UMP). The test bed is 6 metres long and 6 metres high. The test site was chosen on campus because pedestrians on campus have difficulty crossing the street every day due to heavy traffic flows to and from the campus. As a result, our system

prioritises these pedestrians crossing the road safely. The device's viability has been shown by the results of the experiments. For smooth, synchronous, and efficient communication between the two traffic lights, the device works well according to design requirements and specifications.

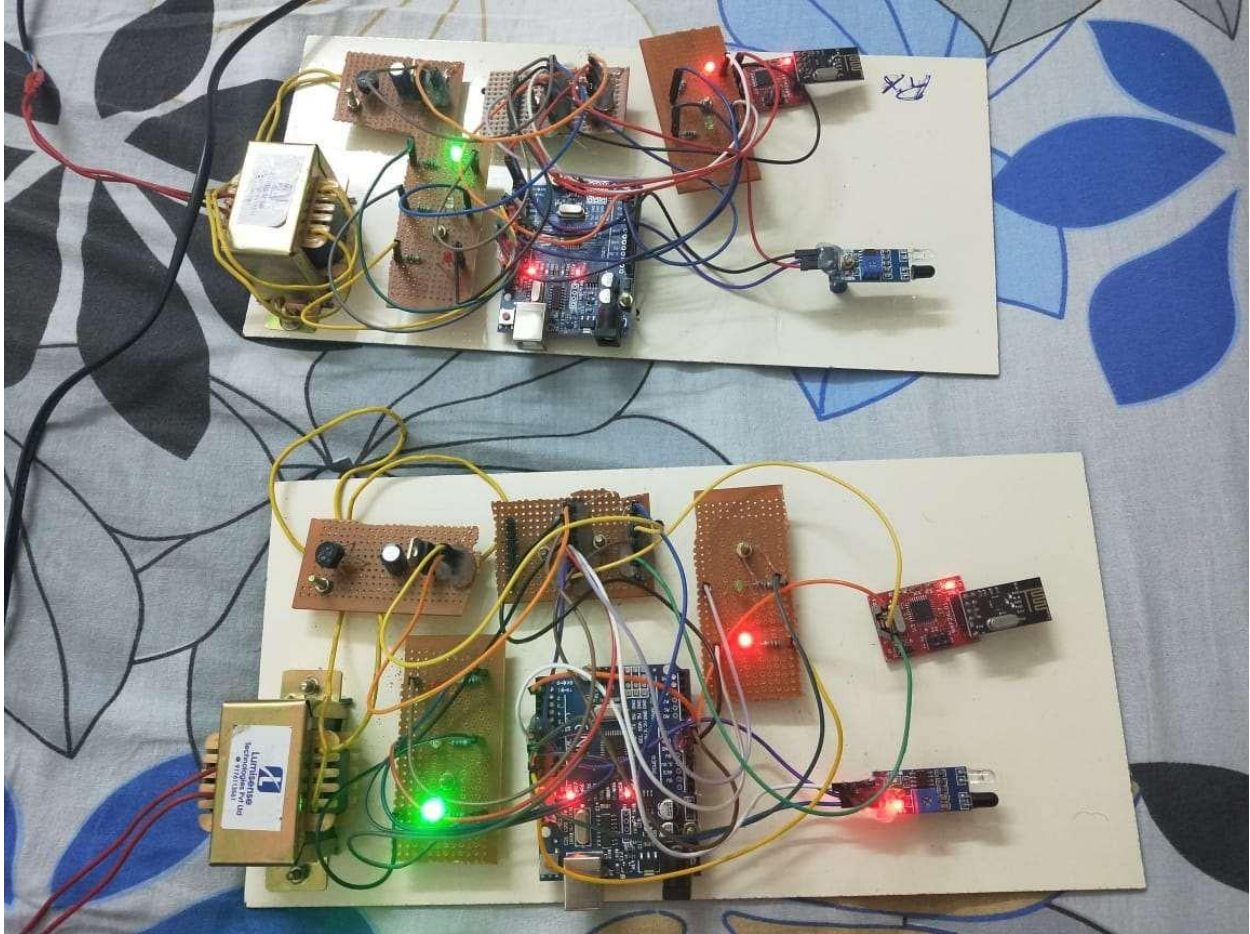


Fig 4.1 Practical Image

CHAPTER 5

CONCLUSION

We created a crosswalk traffic lighting system that operates automatically, intelligently, and wirelessly. An efficient test bed for improving pedestrian safety and comfort by controlling traffic lights automatically based on pedestrian detection. This system allows pedestrians to cross the road without having to wait for the walking signal to be enforced. In addition, we were concerned about the cost of system installation and design, as well as the system's maintenance specifications and energy efficiency. The Zigbee system enables two-way communication between traffic lights on both sides of the road crossing. The system's portability makes it easier to move and deploy students in and out of temporary settings like universities and colleges. The Device testbed saves electricity and lowers electrical bills by using LEDs with rechargeable batteries. This analysis had many flaws that were discovered. One is the infrared sensor, which has a wide range of detectors and can detect objects at a minimum distance of 120 degrees and 3 metres. Since it can identify pedestrians at a distance from the airfield, the IR sensor will give an incorrect signal. In order to overcome this problem, an IR sensor inside a hole is used to reduce the angle to 45 degrees and the sensor detection distance. This paper, we believe, will make significant technical contributions to related applied research to improve transportation infrastructure for feed-back, especially in the Smart City climate. The current study could be expanded by incorporating a solar cell to reduce the reliance on rechargeable batteries in devices. During the day, the solar panel will provide direct power to the unit and charge the battery, which will be used during the night. The use of IoT and 5G communications networks to monitor these crosswalking systems may be beneficial.

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