ENGINEERING DESIGN

DESIGN & IMPLEMENTATION OF TRAFFIC SIGN BOARDS USING RADIO FREQUENCY
PROJECT REPORT

Instructor

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ABSTRACT

Road accidents cause a great loss to human lives and assets. Most of the accidents occur due to human errors, such as bad awareness, distraction, drowsiness, low training, and fatigue. Therefore, a radio frequency identification (RFID) based system can be used due to its lower cost, higher availability, numerous applications and ability to combine with other systems.

In this system, vehicle is able to detect traffic signs which are on the road side boards e.g. "speed limit" or "school" or "turn ahead". Here every road side board or symbol will use one signal transmitter and the moment vehicle passes from that road side board the vehicle will receive signals with the help of receiver and display the symbol on TFT screen which is in the car. So, the driver can concentrate on driving vehicle thus reducing accidents.

INTRODUCTION

Vehicle usage is rising all over the world. This situation causes an increase in the number of accidents and traffic. Annually, road accidents cause about 1.2 million deaths, over 50 million injuries, and global economic cost of over US$ 518 billion. About 90% of the accidents happen due to the driver behavior, such as bad awareness of driving environment, low training, distraction, work over-load or underload, and low physical or physiological conditions. To prevent this situation, major car manufacturers are developing and integrating Advanced driver assistance system (ADAS) to their vehicles. ADAS has important role in increasing the car safety.

Traffic Sign Recognition (TSR) is a part of ADAS technology which was developed for increasing the attention of drivers. This technology uses Image processing techniques to detect the traffic signs. The detection methods can be generally divided into color based, shape based and learning based methods. There are diverse algorithms for traffic sign recognition based on the shape of the sign board. Typical sign board shapes like hexagons, circles, and rectangles define different types of signs, which can be used for classification and then Deep Learning methods are incorporated for traffic sign detection.

TSR technology has many difficulties. Reflections, shadows, not controlled lighting, shape deformation, sign rotation and moreover these systems come only with modern luxury cars because of their high cost and complexity due to several sensors employed. Also, due to other problems like rusting of symbols on road side due to whether, hidden symbols in the trees or somewhat collapsed signs many times while driving driver cannot able to see symbols clearly and may mismatch the massage on road side boards and also not able to drive concentratedly. So, a proposed method of traffic sign recognition based on RFID technology can be used. The general concept of such a system focuses on the use of radio waves to identify previously encoded objects (RFID Transmitters). RFID transmitter modules are placed on a lane store information on the traffic signs situated by this lane, while an RFID reader and system are responsible for the recognition and proper presentation of those signs to the driver.

OBJECTIVE

- The main aim of the project is to reduce the number of accidents by making the road environment better.
- To improve the visibility of traffic signs which in current scenario is frequently obstructed by problems like rusted boards due to weather conditions, hidden symbols in the trees or somewhat collapsed boards.
- Easy visibility of sign boards in all weather conditions.
- To reduce the level of distraction of driver while driving which is caused in attempt to see the symbol of the sign board.
- To update the driver of the roadblock conditions well before time so that the driver can act accordingly.
- Other aims of project includes:
  - Awareness among people about use of sign boards.
  - Easy and smooth flow of traffic thus reduction in traffic jams.
  - Reduction in travel time.

NEED STATEMENT

Requirement of a system that improves the visibility of traffic sign boards, unaffected by view block conditions like rusted or collapsed boards. Also reducing the distraction of driver while driving.

Expectation:
- Simple design
- Cost effective
- Easy installation
- Low maintenance
- Reduce distraction

PRODUCT SPECIFICATIONS

Performance: Should be easy to install in new as well as existing automobiles. Also, it should be compatible with existing technology. The interface should be user-friendly.

Size: Should be of small size so that can be easily fitted in car wherever it performs the best.

Cost: Should be cost effective.

Material: Should withstand even severe weather conditions.

Aesthetics: Must present an image of robustness, reliability, and compactness.

Product life: More than Ten years.

**Maintenance:** Should require less maintenance and should be durable.

Reliability: Should be highly reliable about the signboard which is visited.

Environment: Should withstand even severe temperature.

Ergonomics: The contents of the display screen should be systematically placed so that the information is correctly transmitted.

Customer: The product aims to facilitate every individual who wishes to drive.

QFD
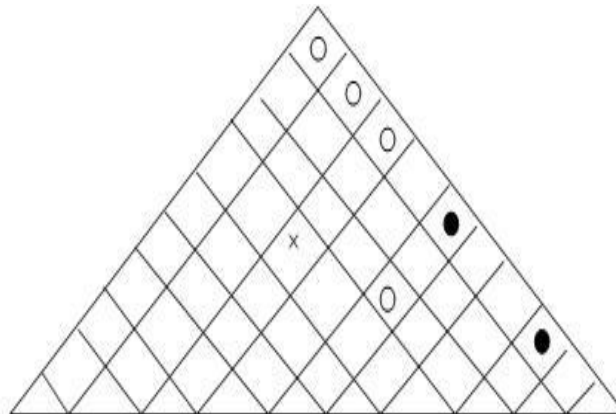
|	Toughness of material	Conductivity of material	Thermal resistance	Size of components	Wireless network	Sound notification	Solar power source	Use of Frequency	Display on LCD	Cost of manufacture	Customer Importance	Existing Product	Planned Product	Improvement Ratio	Sales Point	Improvement Ratio	Relative Weight
Crack-resistant Body	9										4	3	4	1.3	1.3	6.9	0.13
Water-resistant Body		9	1								4	4	4	1	1.3	5.2	0.10
Heat-resistant Body			9				3				4	4	4	1	1.3	5.2	0.10
No internet required					9						4	5	5	1	1.4	5.6	0.11
Compact size				9							2	4	4	1	1.2	2.4	0.04
No visibility blockage								3	1		5	3	5	1.7	1.3	11	0.21
Less power consumption						9					3	5	4	0.8	1.4	3.3	0.06
Less distraction						9			9		3	2	4	2	1.3	7.8	0.15
Cost				3				1	1	9	3	5	4	0.8	1.3	3.1	0.06
Absolute Importance	1.17	0.90	1.0	0.53	0.99	1.89	0.30	0.69	1.62	0.54	9.63						
Relative Importance	0.12	0.09	0.10	0.05	0.10	0.19	0.03	0.07	0.16	0.05							
Technical Competitive Assessment	3	2	2		5	3	3		4								
Technical Difficulty	3	3	3		4	2	4		3								
Direction Of Movement				↓													
Target Value	4083	9	0.02														
Unit	J/m3	W/mK	W/mK														

50.5

CONCEPT USED

ABSTRACT

The transmitter(made using nRF module) contains electronically stored information. These transmitters use a local power source(battery or a solar cell).
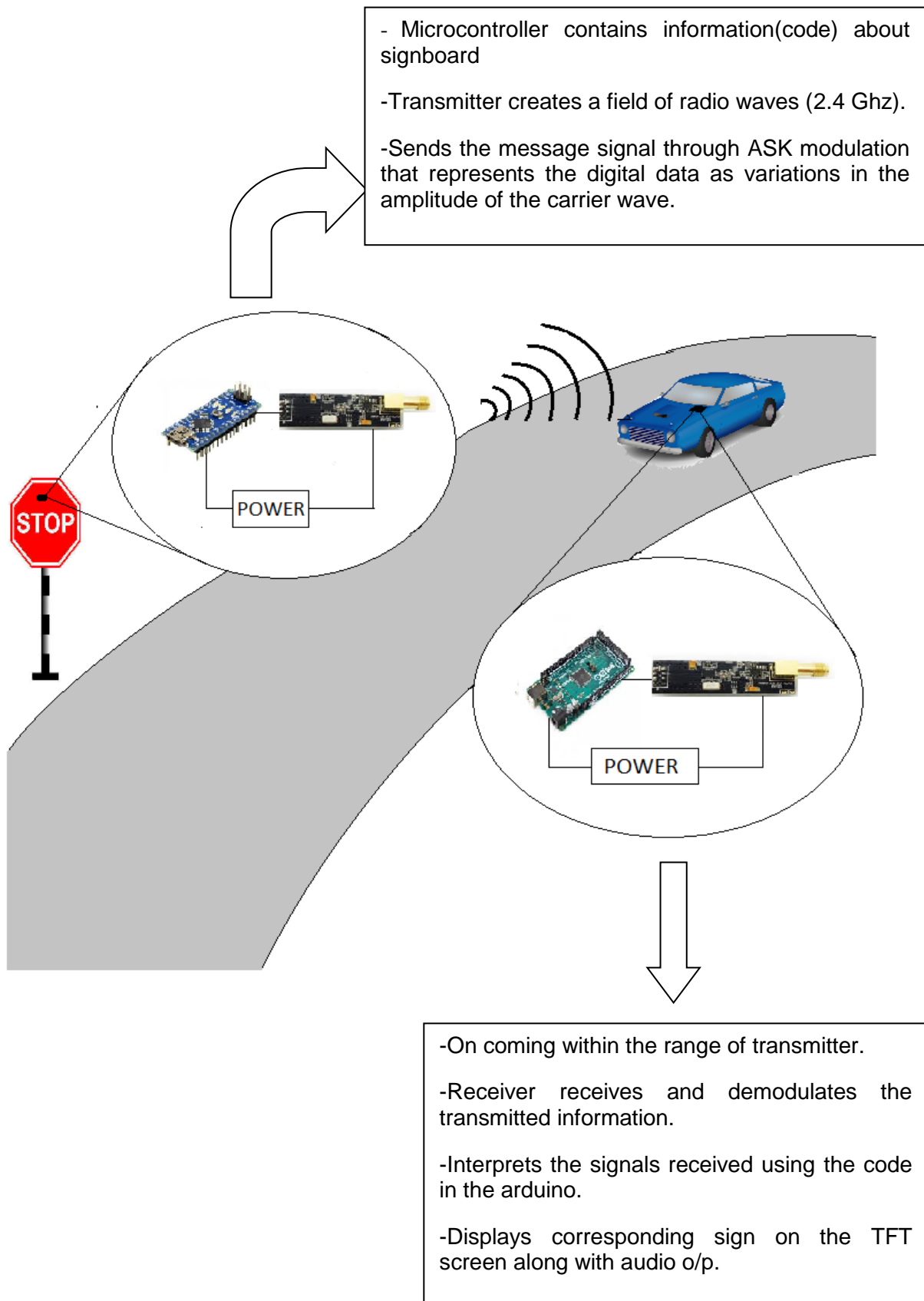They have range upto 50 meters. nRF modules can be programmed to worked both transmitter and receiver.
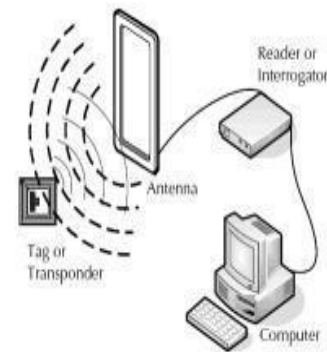
There are 63 sign boards in India. We will appoint a unique code to each of the transmitter module attached to these signs. As soon as a vehicle with the receiver comes in the range of the transmitter, it will send the unique code which will be received by the reader in the car. The microcontroller in the reader will decode the encoded data received and show the corresponding sign on the led screen of the vehicle with an audio alert through a buzzer.
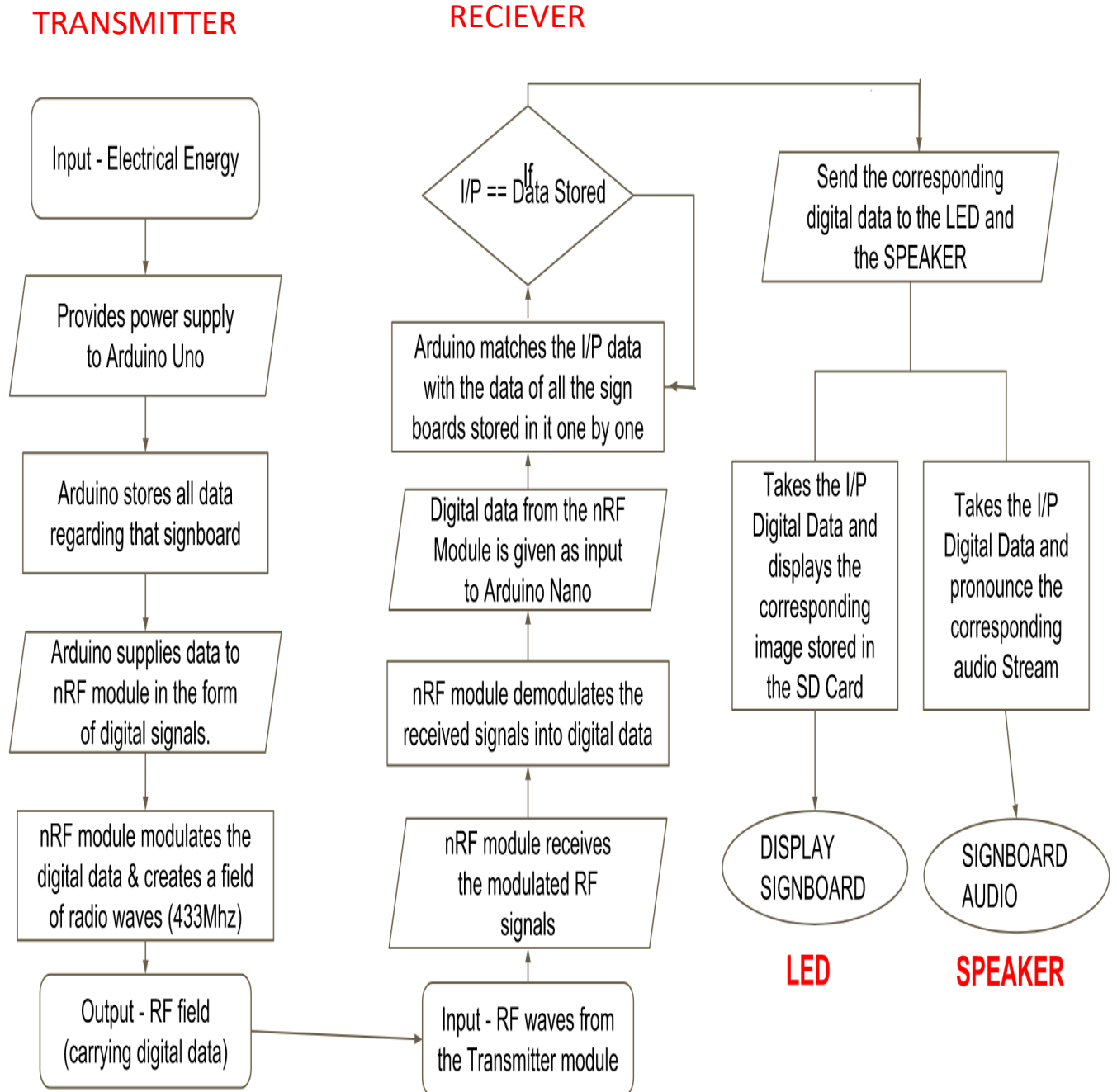
Advantages of the nRF over the other methods:
- It only requires a transmitter and a receiver, to warn the driver of the sign board. It is not dependent on any technology such as GPS or Internet which in India is not a reliable(constant) resource in terms of availability.
- The cost of the components to implement this method is comparatively less.
- The life of the product will be larger than the others as the reader will be placed in the car at a place where it won't be affected by the surrounding conditions. So, it will depend on the lifetime of the transmitter module which is high.
- Installation, the maintenance cost and labor is very less as compared to the other methods like VANET and GPS which will require huge effort for keeping the system up-to-date.
- It would be unaffected with the direct view of sign board which is often blocked by bushes, rusting or due to collapsed boards.

Our Product

- Microcontroller contains information(code) about signboard

-Transmitter creates a field of radio waves (2.4 Ghz).

-Sends the message signal through ASK modulation that represents the digital data as variations in the amplitude of the carrier wave.

STOP

POWER

POWER

-On coming within the range of transmitter.

-Receiver receives and demodulates the transmitted information.

-Interprets the signals received using the code in the arduino.

-Displays corresponding sign on the TFT screen along with audio o/p.

FUNCTIONAL FLOW

TRANSMITTER

- Input - Electrical Energy
- Provides power supply to Arduino Uno
- Arduino stores all data regarding that signboard
- Arduino supplies data to nRF module in the form of digital signals.
- nRF module modulates the digital data & creates a field of radio waves (433Mhz)
- Output - RF field (carrying digital data)

RECIEVER

- If I/P == Data Stored
- Arduino matches the I/P data with the data of all the sign boards stored in it one by one
- Digital data from the nRF Module is given as input to Arduino Nano
- nRF module demodulates the received signals into digital data
- nRF module receives the modulated RF signals
- Input - RF waves from the Transmitter module

- Send the corresponding digital data to the LED and the SPEAKER
- Takes the I/P Digital Data and displays the corresponding image stored in the SD Card
- Takes the I/P Digital Data and pronounce the corresponding audio Stream
- DISPLAY SIGNBOARD — **LED**
- SIGNBOARD AUDIO — **SPEAKER**

COMPONENTS USED

Following components are used for the **Roadside Sign Board Recognition System using RFID**

- nRF24L01 module for transmitter and receiver (electronically programmed with unique information)

- TFT Screen and Speakers (for audio visual output)

- Microcontroller (Arduino U & Arduino Mega)

- Accessories (Jumper Wires, Battery)

nRF21L01 Module

These modules will be placed on the signboards as a part of the transmitter with information about the corresponding signboard and also near the car dashboard as a part of the receiver. The nRF24L01 is a highly integrated, ultra low power (ULP) 2Mbps RF transceiver IC for the 2.4GHz ISM (Industrial, Scientific and Medical) band. With peak RX/TX currents lower than 14mA, a sub µA power down mode, advanced power management, and a 1.9 to 3.6V supply range, the nRF24L01 provides a true ULP solution enabling months to years of battery lifetime when running on coin cells or AA/AAA batteries.

Why nRF24L01?

- Low power consumption (12mA and 1.9V - 3.6V)

- No logic level converter required

- Broad rate 250 kbps to 2 mbps

- 2.4 Ghz bandwidth which have range of upto 100 meter.

- Multi Receiving possible (SPI communication)
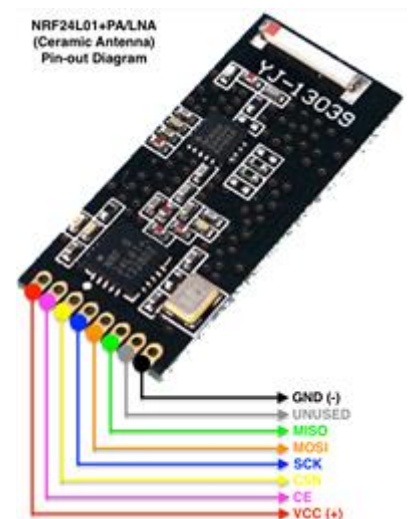
TFT Screen and Buzzer

Driver would be able to see the visual output of the traffic sign on the TFT screen of 2.4'' in the form of an appropriate message and drive accordingly. **Size of the TFT screen would be 2.4''**. This do all monitor accepts every type of input and you can enjoy an HD quality image.. The monitor operates on 12 volts and can be used in a home or car. Initially 16x2 LCD display was used but due to the poor display quality and small size it had to be replaced with the 2.4'' TFT display. It has slots for microSD Card, has a capacitative Touch Screen Feature. Colored Display.

Microcontroller

The Arduino Nano based on the ATmega328 is used as microcontroller board. It is programmed using Arduino software. Arduino is an open-source electronics platform based on easy-to-use hardware and software. I's intended for anyone for anyone making interactive projects.

Arduino Nano is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

CIRCUITS

TRANSMITTER MODULE

It includes the nRF24L01 module for transmission of the information through RF waves, an adapter to regulate the voltage, for the nRF24L01 as It regulates the 5V input to 1.9~3.6V DC and incorporates bypass capacitors for reliable operation, an antenna to increase the strength and range of the radio waves and a microcontroller (Arduino Nano) which contains the information about the respective signboard.

Arduino Uno/ Nano - NRF24L01
3.3V - VCC
GND - GND
8 - CSN
7 - CE
13 - SCK
11 - MOSI
12 - MISO
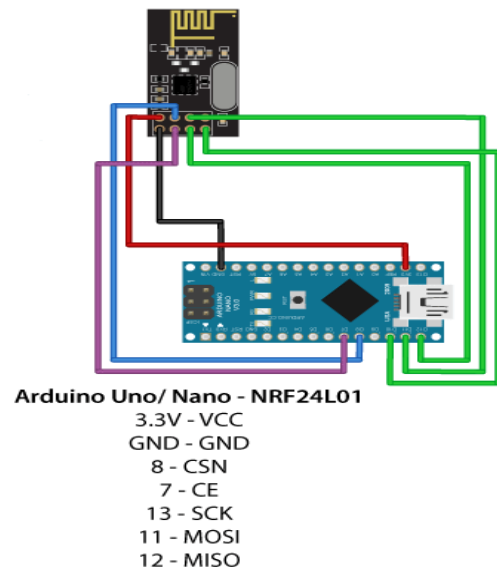
RECEIVER MODULE

It includes the nRF24L01 module for transmission of the information through RF waves, an adapter to regulate the voltage, for the nRF24L01 as It regulates the 5V input to 1.9~3.6V DC and incorporates bypass capacitors for reliable operation, an antenna to increase the strength and range of the radio waves and a microcontroller (Arduino Mega) which contains the information about the all the signboards and will match the respective sign to provide input to TFT and buzzer.

Arduino Mega - NRF24L01
3.3V - VCC
GND - GND
8 - CSN
7 - CE
52 - SCK
51 - MOSI
50 - MISO

VCC GND
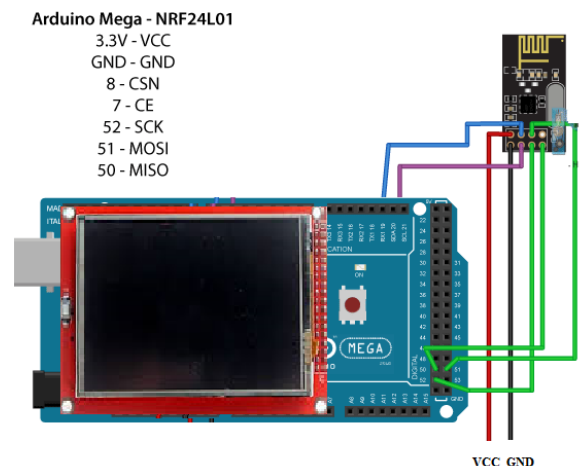
COST ESTIMATION

S NO.	COMPONENT	PRICE (₹)	QUANTITY (₹)	TOTAL (₹)
1	NRFL01 with Antenna	395	2	790
2	NRF24L01 Adapter	200	2	400
3	Jumper wires set	279	1	279
4	Speaker	145	1	145
5	2.4'' TFT Display	534	1	534
6	Arduino Nano	399	2	798
7	Arduino Mega	820	1	820
		TOTAL		3766

PRODUCT

RECEIVER

TRANSMITTER

RESULTS

It is well known that the road signs play a vital role in road safety. Its ignorance results in accidents. This project proposes an Idea for road safety by using a frequency based traffic sign recognition system. By using it we can prevent the road risk up to a great extent. By using nRF as a digital sign, it will be able to recognize almost all type of signs at different day timing and weather conditions. Improving system performance in night time and with high speed and also large number of traffic signs used for training the neural network, are few works which need further advancement of the system. We will conduct our research further to improve the robustness of this new approach so that it can perform better in all kinds of atmospheres and luminance conditions. Then, it was found that providing visual and vocal information in the vehicle was effective.

BROCHURE

ABOUT RFID TECHNOLOGY

Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects.

WE WORK FOR YOU

We work for future

SIGNOLECTOR

DETECTION OF SIGN BOARDS USING RFID

DESIGN & IMPLEMENTATION BY

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OUR PRODUCT

Our product uses RFID (Radio Frequency Identification) to help warn the driver about the signboard ahead in a visual and audio alerts. A product includes a nRF24L01 module which is used in both the transmitter and receiver, which in turn communicate with each other, thus providing the visual output along with audio buzzer.

OUR VISION

- Increasing the safety at roads for the drivers and pedestrians
- improving the the visibility of the signboard to the driver.
- There have been many accidents due to the reason that the sign boards are not followed properly.
- We through our product aim to improve this scenario.

ADVANTAGES

- Independent of unreliable technologies like GPS and Internet
- Cheaper than other products in the field.
- Provides reliable results.
- The life of our product is large.
- Blockage of the sign board doesn't affect the result.

LOGO

POSTER