“RoboSantral: An Autonomous Guide Robot”

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY

IN THE PARTIAL FULFILLMENT OF THE

REQUIREMENT FOR THE PROJECT

B.E.(Electronics and Telecommunication)

Savitribai Phule Pune University

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2016-17

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CERTIFICATE

This is to certify that the **Manzoor Ambekar**, **Prasad Bomble** and Kuldeep A. Tekale the students of BE Electronics & Telecommunication Engineering, J.S.C.O.E. Hadapsar have submitted their project entitled **"RoboSantral: An Autonomous Guide Robot"** under supervision and guidance of **Prof. D. G. Ingale** for the fulfillment of the requirement for the subject of Project & Seminar for the B.E. (E&TC) during academic year 2016-17 of University of Pune.

Date: / /2016

Place: Pune

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ACKNOWLEDGEMENT

We have a great pleasure in representing this work on "RoboSantral: An Autonomous Guide Robot". During this work we are bound to rely on the assistance in providing constant suggestions, constant guidance during project work.

We wish to thank Prof. D. G. Ingale, our project guide as well as the head of department Dr. D. B. Salunke for their continuous guidance, precious suggestions, co-operation and motivation in preparation of this project report.

We are also grateful to our respected Principal Dr. M. G. Jadhav for his cooperation despite his busy schedule. It is our privilege to extend our deep thanks to our project guide Prof. D. G. Ingale. In every step of the project we had the benefit of advice and criticism. We are obligated to thank all the qualified staff of the Electronics and Telecommunications Dept., JSCOE, Pune for its constant inspiration, timely suggestions and moral support.

ABSTRACT

RoboSantral, an autonomous mobile robot which has been designed and realized in order to guide the visitors through a museum. This robot accompanies guests through the museum and gives presentations on predefined locations. Location data is obtained from RFID tags pasted on particular location.

A RFID reader reads the targets such as faculty buildings, museums etc. These are recognized by the pre-defined tags. A voice playback unit using SD card is used to playback the information of particular location. IR sensors are used for obstacle detection.

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CHAPTER: 1

1.1 INTRODUCTION

Mobile robots which came as an alternative to the stationary constraints of the industrial robots first had missions such as exploring other planets or inhospitable areas on Earth, collecting geological samples. As the costs of mobile robots come down, the fields of use are extending rapidly, including the daily use of mobile robots.

In this paper an autonomous mobile robot that is designed and developed to greet and guide the visitors of a university campus is presented. Besides halls, theatres, concert areas, libraries and museums, university campuses are preferred locations of artistic exhibitions and cultural activities. This makes university campuses a center of attraction not only for the students but also for the native and international visitors. When the required manpower for introduction and guidance of crowded visitors is considered, a mobile robot with navigation capabilities turns out to be a desirable choice.

The autonomous mobile guide robot RoboSantral was designed to fulfill this need. RoboSantral has several different components such as Microcontrollers, LCD screen, sensors, speakers, DC motor drive controller. In the design, components were integrated in order to implement a self-navigating, introductive guide robot. Guidance tasks are achieved with the data from surroundings processing on RoboSantral's software. Following sections of this paper presents information on the design, implementation and the test phases of RoboSantral.

There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising unemployment as they replace workers in increasing numbers of functions.[10] The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the future.

The idea of a tour guide robot in a museum environment has already been addressed several times in the past. Within those projects the museum specific part of the story is usually limited to showing around visitors and presenting information to the exhibits or in the sense of a concierge robot to point out interesting exhibitions. For our project of a tour guide robot, the interactive and entertaining presentation of information is one of our main goals. Our project demonstrator is situated in a historical computer science exhibition. From our experience, a lot of users are not particularly interested in vintage computer hardware. Furthermore, one has to argue for such projects about the benefits over a human presenter.

The idea of automata originates in the mythologies of many cultures around the world. Engineers and inventors from ancient civilizations, including Ancient China, Ancient Greece, and Ptolemaic Egypt, attempted to build self-operating machines, some resembling animals and humans. Early descriptions of automata include the artificial doves of Archytas,[16] the artificial birds of Mozi and Lu Ban, a "speaking" automaton by Hero of Alexandria, a washstand automaton by Philo of Byzantium, and a human automaton described in the Lie Zi.

1.2 LITERATURE SURVEY

Sr. No	Author Name	Research Paper Title	Abstract /Summery	Published Month & Year
1	Asraa Al-Wazzan, Farah Al-Ali, Rawan Al-arhan,Mohammed El-Abd	Tour-Guide Robot.	In this work, we introduce the implementation of a tour-guide robot using Kinect technology to ease the process of tourist guides. The robot will replace the current human guide.	March 2013
2	Marc Donner, Marian Himstedt, Sven Hellbach, Hans-Joachim Boehme	Awakening history: Preparing a museum tour guide robot for augmenting exhibits.	While the idea of tour guide robots has been addressed several times, applying a video-projector based augmented reality component to this scenario is rather new. We show requirements of the localization system of the robot and how they can be fulfilled, as well as a basic system for projection correction and its suitability for this scenario.	Sept 2014
3	A.Denker, A. U. Dilek, B. Sarıoğlu, J. Savaş, Y.D. Gökdel	RoboSantral: An autonomous mobile guide robot.	RoboSantral, An autonomous mobile robot which has been designed and realized in order to guide the visitors through a university campus, is presented in this paper. This robot accompanies guests through the campus and gives presentations on predefined locations.	March 2015

CHAPTER: 2

2.1 What Is Robot:

A robot (also called a droid) is a machine especially one programmable by a computer—capable of carrying out a complex series of actions automatically.[2] Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed to take on human form but most robots are machines designed to perform a task with no regard to how they look.

Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's Advanced Step in Innovative Mobility (ASIMO) and TOSY's TOSY Ping Pong Playing Robot (TOPIO) to industrial robots, medical operating robots, patient assist robots, dog therapy robots, collectively programmed swarm robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nano robots. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. Autonomous Things are expected to proliferate in the coming decade, with home robotics and the autonomous car as some of the main drivers.

The branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing is robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. These robots have also created a newer branch of robotics: soft robotics.

From the time of ancient civilization there have been many accounts of user-configurable automated devices and even automata resembling animals and humans, designed primarily as entertainment. As mechanical techniques developed through the Industrial age, there appeared more practical applications such as automated machines, remote-control and wireless remote-control.

The word 'robot' was first used to denote a fictional humanoid in a 1920 play R.U.R. by the Czech writer, Karel Čapek but it was Karel's brother Josef Čapek who was the word's true inventor. Electronics evolved into the driving force of development with the advent of the first electronic autonomous robots created by William Grey Walter in Bristol, England in 1948. The first digital and programmable robot was invented by George Devol in 1954 and was named the Unimate. It was sold to General Motors in 1961 where it was used to lift pieces of hot metal from die casting machines at the Inland Fisher Guide Plant in the West Trenton section of Ewing Township, New Jersey.

Robots have replaced humans in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments such as outer space or the bottom of the sea.

There are concerns about the increasing use of robots and their role in society. Robots are blamed for rising unemployment as they replace workers in increasing numbers of functions.[10] The use of robots in military combat raises ethical concerns. The possibilities of robot autonomy and potential repercussions have been addressed in fiction and may be a realistic concern in the future.

2.2 Materials And Methods:

The Tour Guide Robot was designed to fulfill this need which has several different components such as Arduino, Raspberry-Pi, LCD screen, sensors, speakers, motion kits… In the design, components were integrated in order to implement a self-navigating, introductive guide robot. Guidance tasks are achieved with the data from surroundings processing on Tour Guide Robot's software

There is a fundamental approach behind every successful mobile robot application. The integration of the different parts of a mobile robot has an extreme importance in design. This robot accompanies guests through the campus and gives presentations on predefined locations. Location data is obtained from GPS sensors. Targets such as faculty buildings, museums etc... are recognized by the image processing of pre-defined tags. As microprocessor and microcontroller, Raspberry Pi and Arduino are used respectively.

The Tour Guide Robot uses the metjjodology of image processing .the initial cost can be high depending on system use.If the computer crashes then images that have not been prinyed will be lost. camera suffers from memory card problems , high cost and battery problem.

therefore, for avoiding such disadvantages of image processing , which is complex method and time consuming , we have used a RF-ID based system named ROBOSANTRAL.

RoboSantral, an autonomous mobile robot which has been designed and realized in order to guide the visitors through a museum. This robot accompanies guests through the museum and gives presentations on predefined locations. Location data is obtained from RFID tags pasted on particular location.

A RFID reader reads the targets such as faculty buildings, museums etc. These are recognized by the pre-defined tags. A voice playback unit using SD card is used to playback the information of particular location. IR sensors are used for obstacle detection.

2.3 OPERATING PRINCIPLE

Input block that collects the environmental data are RFID reader & IR sensor. These blocks make RoboSantral able to understand different types of environmental data.

Infra-red sensors on the input block are placed on the front side. When this sensor met an obstacle within 50 cm, the robot stops and it will activate the buzzer. Robot receives sufficient information and is able to change the direction accordingly.

Motor driving is achieved through the DC motor driver (L293D). On the robot 12 V/200-rpm motors are driven by the motor driver. Motor driving manages the currents going to the wheels therefore turns and a balanced straight movement is possible. RoboSantral recognizes certain forum in a campus using the predefined location RFID tags. These tags help to identify the specific location. Recognition of a RFID tag tends the microcontroller to instruct the Voice playback unit to audio out the saved voice file.

2.4 HARDWARE AND SOFTWARE REQUIREMENTS:

HARDWARE REQUIREMENTS:

- PIC 16F877A Microcontroller ,
- 16x2 LCD
- RFID Reader
- RFID Tags
- Voice Play Unit Using SD Card ,
- Speaker
- DC Motors & L293D Dc Motor Driver
- IR Sensors
- LM 386 -2 Watt Audio Amplifier
- 12 Volt Battery
- 8 Ohm – 0.5 Watt Speaker

SOFTWARE REQUIREMENTS:

- Embedded C or Assembly Language Programming.
- Proteus 8.0 for Circuit design, Layout & Simulation.

2.4.1 PIC16F87XA:

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory. Up to 368 x 8 bytes of Data Memory (RAM). Up to 256 x 8 bytes of EEPROM Data Memory.
- Pin out compatible to other 28-pin or 40/44-pin. PIC16CXXX and PIC16FXXX microcontrollers.
- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare PWM modules
  1. Capture is 16-bit, maximum resolution is 12.5 ns
  2. Compare is 16-bit, maximum resolution is 200 ns

  PWM maximum resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR).

2.4.2 Special Microcontroller Features:

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control

- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection, power saving Sleep mode, Selectable oscillator options, In-Circuit Debug (ICD) via two pins.

2.4.3 16x2 Character LCD:

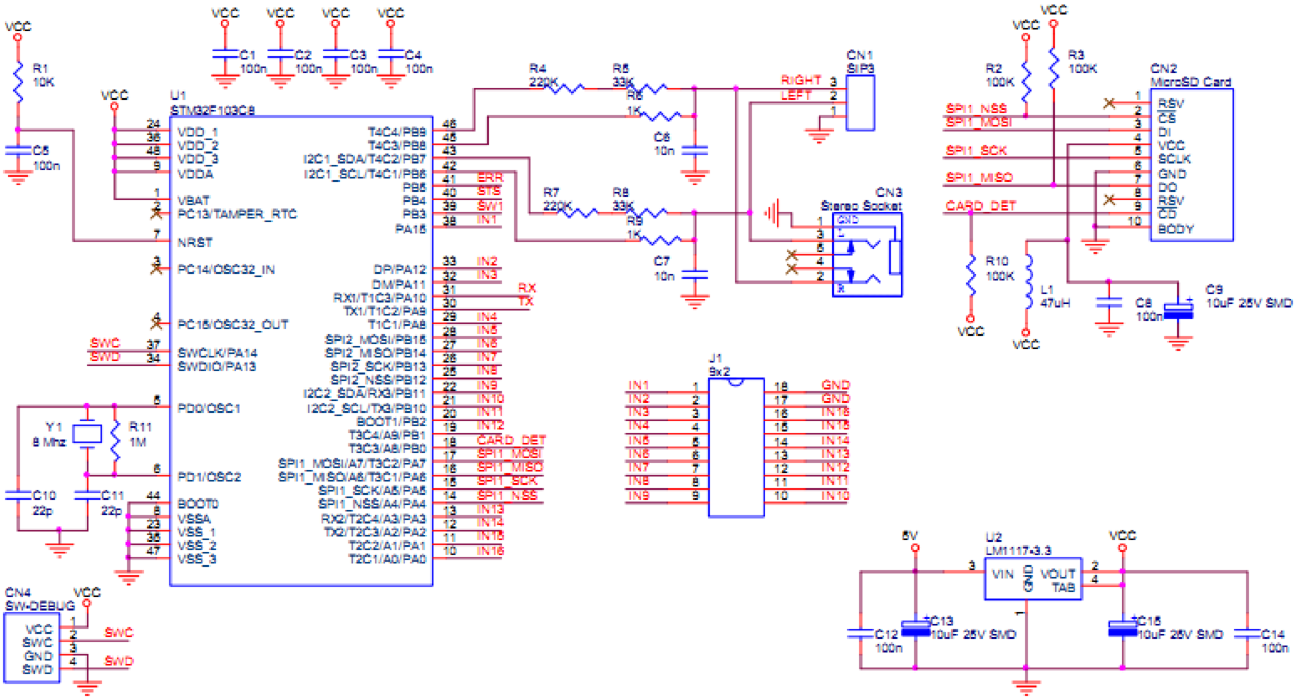
- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

2.4.4 RFID Module:

- Easy to Use RFID Modem.
- It provides UART and TTL Interface.
- RFID module is EM18 Module based.
- Small outline design.
- It contains transmitter LED indicator.
- Low-cost method for reading passive RFID transponder tags.
- 9600 bps serial interface at 5V TTL level for direct interface to microcontrollers
- Buzzer & LED indicate valid RFID Tag detection
- Range up to 7 cm for 125 KHz RFID Cards or Key chains.

2.4.5 Voice Playback Unit:

- Low cost module for all embedded audio-sound applications
- Plays high quality audio of 44.1 KHz
- Can interface with any microcontroller or PC Serial port
- Accepts any Micro SD Card from 128MB to 32GB which is FAT16 or FAT32
- Compact size measuring only 3cm x 6cm.



2.4.6 Push-Pull Four Channel Driver With Diodes (L293D):

- 600ma output current capability per channel
- 1.2a peak output current (non-repetitive) per channel enable facility
- Over temperature protection
- Logical ”0” input voltage up to 1.5 v (high noise immunity)
- It contains internal clamp diodes.

2.4.7 LM 7805 Features:

- Output current up to 1A
- Output voltages +5V
- Short circuit protection
- Thermal overload protection

2.4.8 1N4001 Features:

- Low forward voltage drop
- High current capability
- High reliability
- High surge current capability
- Exceeds environmental standards of MIL-S-19500/228

2.5 BLOCK DIAGRAM

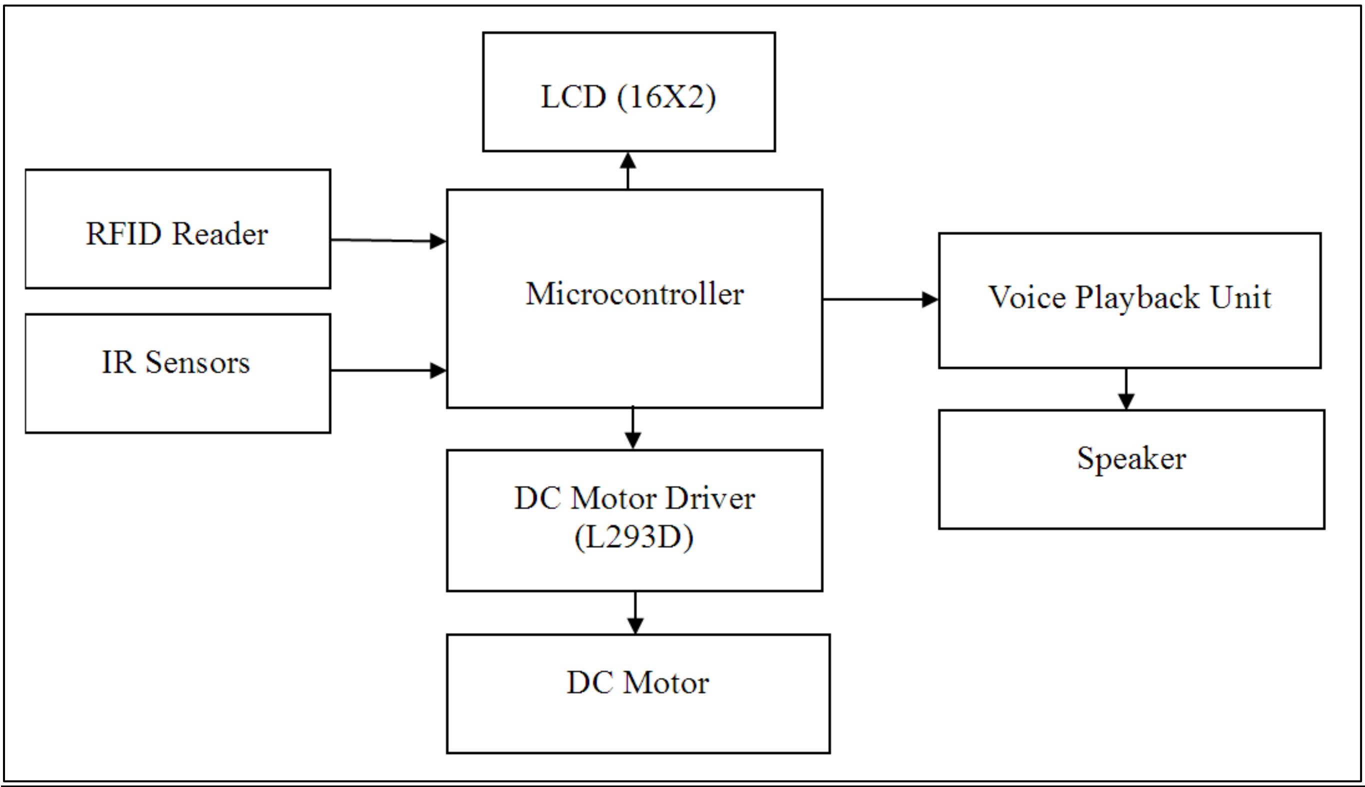


Fig.1: Block diagram of RoboSantral.

CHAPTER: 3

3.1 WORKING

3.1.1 Power Supply:

In mains-supplied electronic systems the AC input voltage must be converted into a DC voltage with the right value and degree of stabilization. In these basic configurations the peak voltage across the load is equal to the peak value of the AC voltage supplied by the transformer's secondary winding. For most applications the output ripple produced by these circuits is too high. However, for some applications - driving small motors or lamps, for example - they are satisfactory. If a filter capacitor is added after the rectifier diodes the output voltage waveform is improved considerably.

The power supply shall be capable of supplying full-rated output power over two input voltage ranges rated 100-127 VAC and 200-240 VAC Rms nominal. The correct input range for use in a given environment may be either switch-selectable or auto-ranging. The power supply shall automatically recover from AC power loss. The power supply must be able to start up under peak loading at 90 VAC.

Ripple and noise are defined as periodic or random signals over a frequency band of 10 Hz to 20 MHz Measurements shall be made with an oscilloscope with 20 MHz of bandwidth. Outputs should be bypassed at the connector with a 0.1µF ceramic disk capacitor and a 10µF electrolytic capacitor to simulate system loading.

3.1.2 RFID Reader:

Radio Frequency Identification (RFID) Card Readers provide a low-cost solution to read passive RFID transponder tags up to 7 cm away. This RFID Card Reader can be used in a wide variety of hobbyist and commercial applications, including access control, automatic identification, robotics navigation, inventory tracking, payment systems, and car immobilization. The RFID card reader read the RFID tag in range and outputs unique identification code of the tag at baud rate of 9600. The data from RFID reader can be interfaced to be read by microcontroller or PC.

Figure 3: RFID Reader Module

3.1.3 L293D Quadruple Half-H Drivers:

The L293D devices are quadruple high- current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-L293D) supply applications.

Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN.

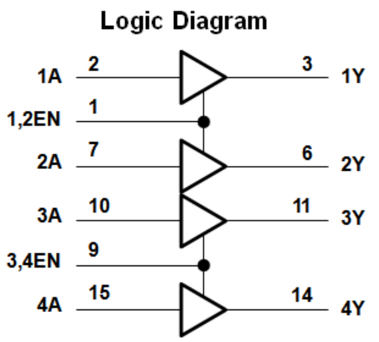


Figure 4: Logic diag. of RFID

3.1.4 Positive Voltage regulator (7805):

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.

3.2 CIRCUIT DIAGRAM

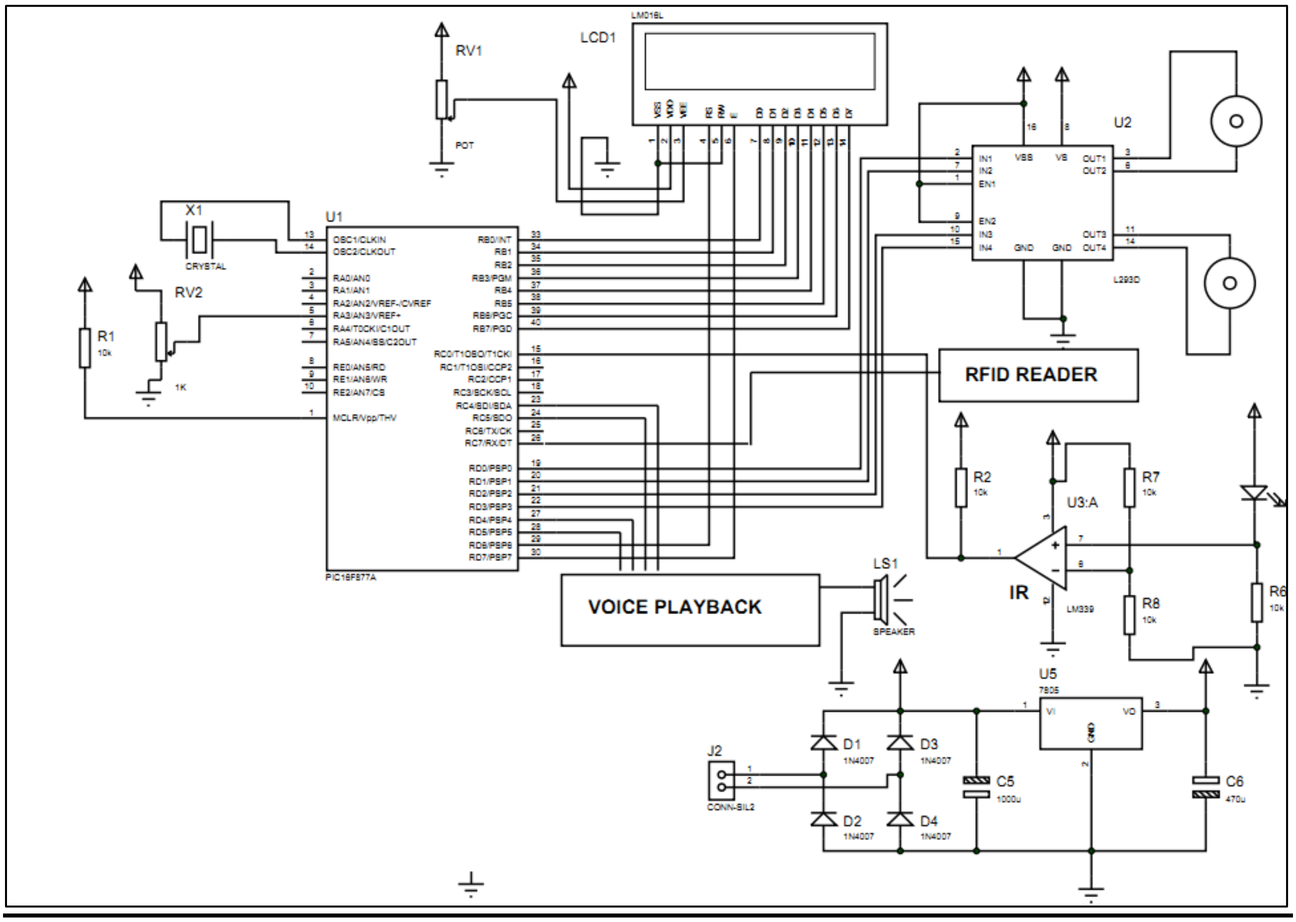
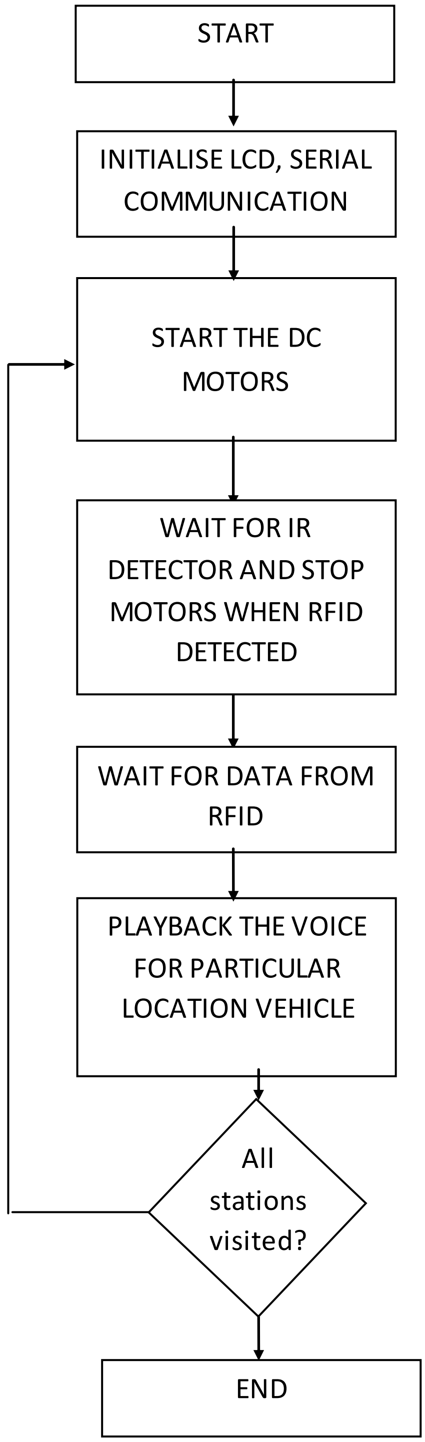
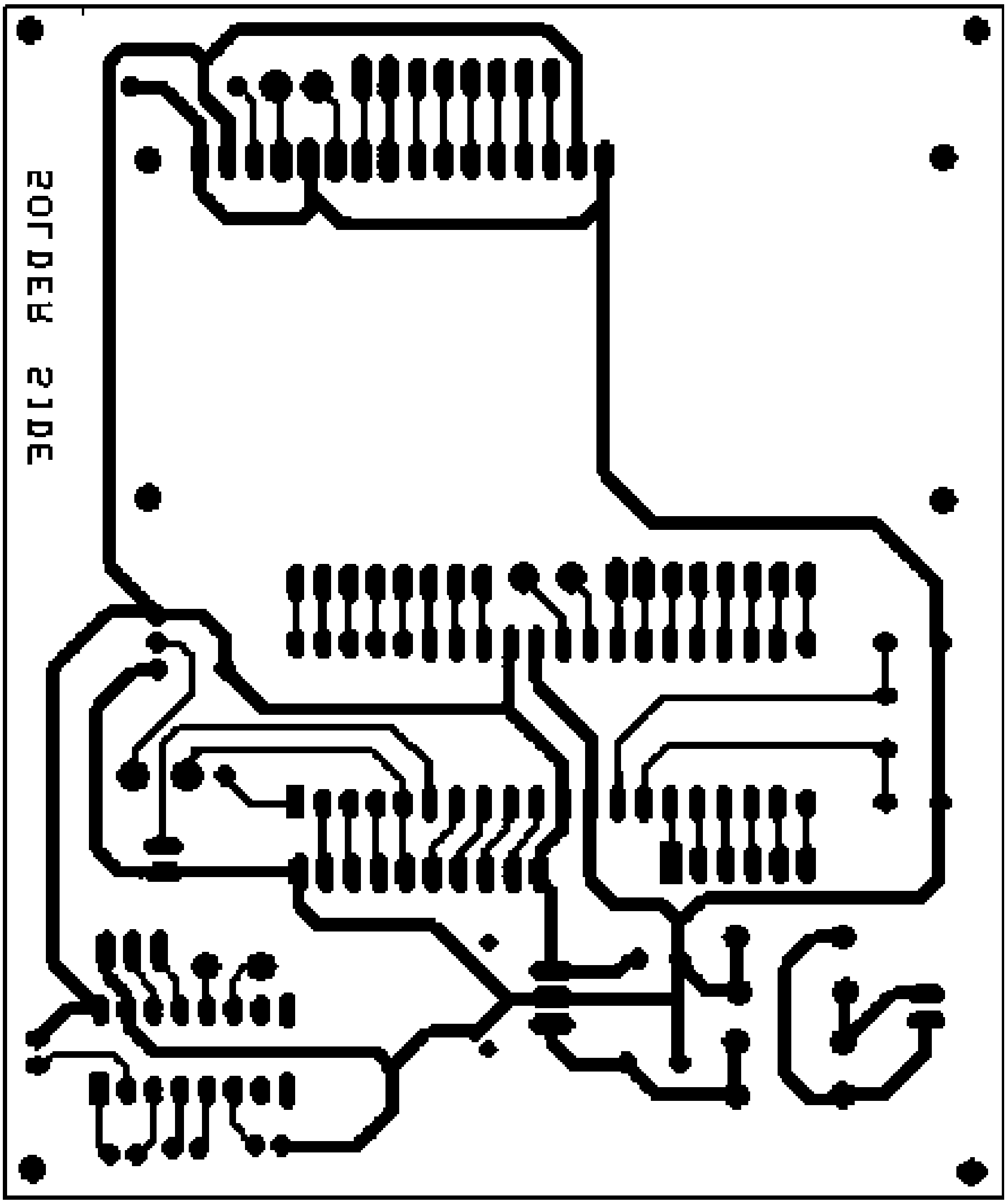


Fig. 2: Circuit Diagram of RoboSantral

3.3 FLOW CHART



3.4 CIRCUIT LAYOUT



CHAPTER: 4

4.1 SOFTWARE STEPS

Type a program and save it as <.asm>.

Go to microchip.com.

Install the MPLAB IDE 8.0 software.

Open mpasmwin.

Then go to source, then into the window enter the path in .asm .

Then select controller 16F877A.

Then make it assemble and compile it .

If the program is correct and successful it will generate Hex file.

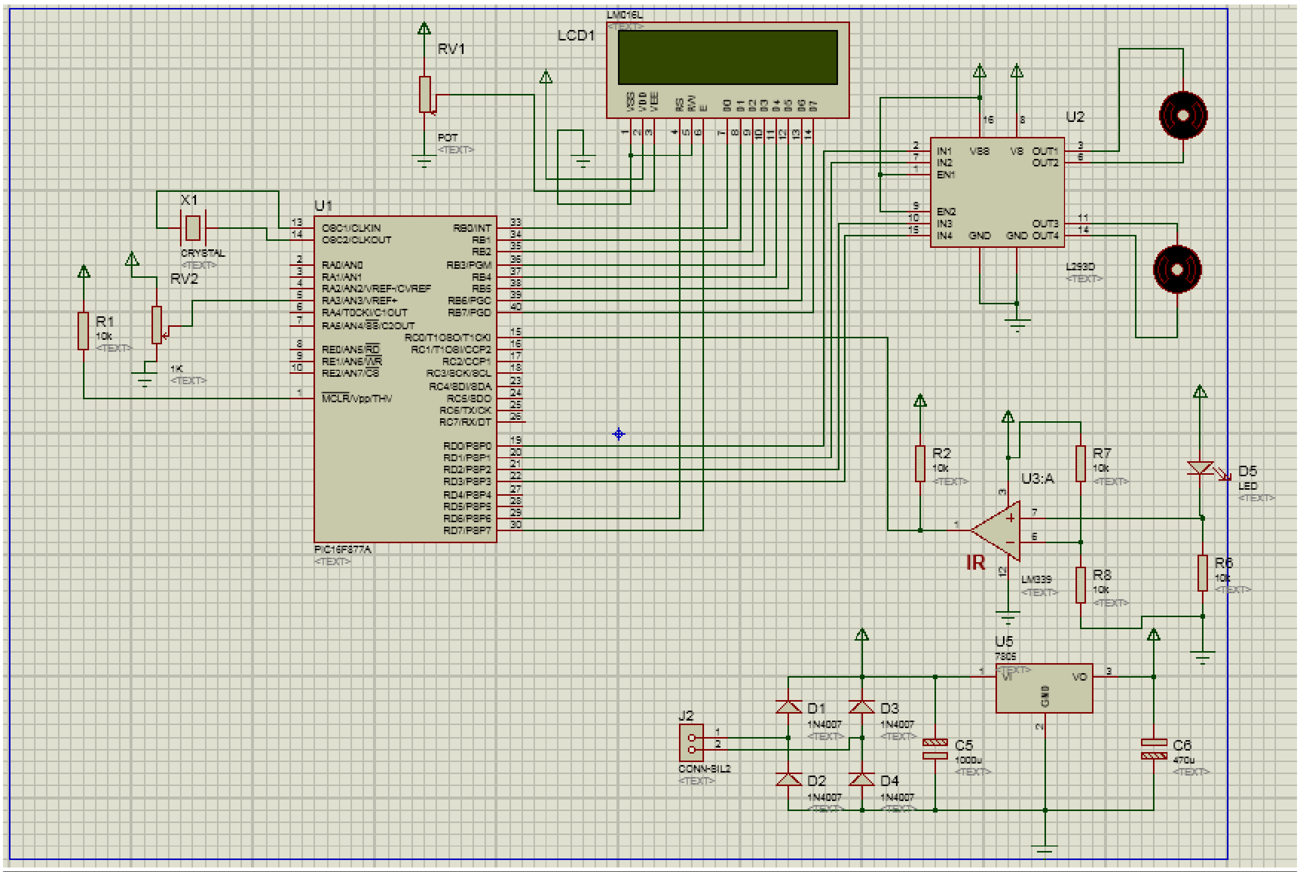
If the program is not successful then it will generate (.err) & (.lst) files.

Correct / rectify it and remove errors.

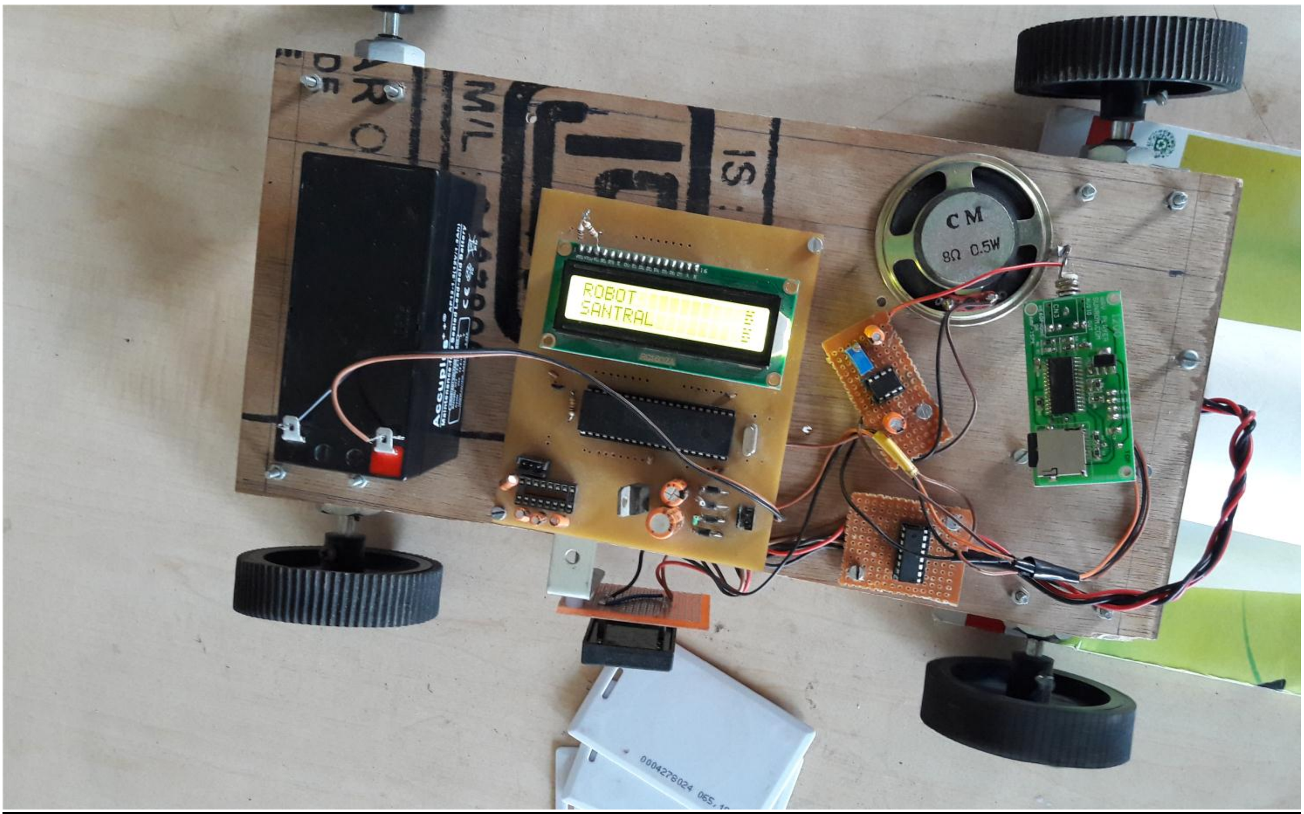
Using PICKKIT2 programmer, download the code using USB port.

Then burns the IC and then IC is ready to use.

4.2 CIRCUIT SIMULATION



4.3 ACTUAL HARDWARE DESIGN



4.4 ADVANTAGES

- Totally automated system.
- Easy to use & require no special training or equipment.
- Reprogramming for different application is possible.
- Voice playback can be saved in many languages.
- Many other circuits can be implemented in the future for security or interactive response.

4.5 RELEVANCE TO THE PRESENT INDUSTRIAL SCENARIO

- This robot can be used in hospitals to send medicines to patients.
- It can be used for industrial purpose to place the products at particular locations.
- It can be used in museums to guide the visitors through different locations with audio playback services.
- It replaces human interaction for guiding purpose.

CHAPTER: 5

5.1 CONCLUSION

Assemble the circuit on a general-purpose PCB and enclose it in a suitable box. This circuit is very useful in field of electronic circuits. By using some modifications in it, area of application can be extended in various fields. It can be used for industrial purpose for guiding the products at particular locations or in hospitals to send medicines to patients.

This project gives us a great deal of knowledge about different type of sensors and identification devices and their interfacing to achieve common task.

5.2 FUTURE SCOPE

- We can include camera for dual purpose i.e. one for security and other one for image processing.
- The robot can be interactive.
- We can include visitor counter.
- We can include display in order to represent videos.
- Touchpad or Keypad can be included for change in destination points.
- Auto rechargeable batteries can be implemented.

5.3 REFERENCES

[1] B. Sciliano ve O. Khatib, Springer *Handbook of Robotics*, Springer-Verlag, 2008.

[2] R. Siegwart, IR Nourbakhsh ve D. Scaramuzza, *Introduction to Autonomous Mobile Robots*, MIT Press, 2011.

[3] P.Corke,*Robotics, Vision and Control*, Springer tracts in advanced robotics, 2011