

VIETNAM AVIATION ACADEMY

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PROJECT REPORT:

"Radar detector module using Arduino"

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PREAMBLE

Radar is an object detection system. It uses Microwaves to determine the range, altitude, or speed of objects. The radar can transmit radio waves or microwaves which bounce off any object in their path. So, we can easily determine any object in the radar range. Arduino is a single-board microcontroller to make electronics more discipline. The radar system has different performance specifications and also it comes in a variety of size.

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Chapter 1

Introduction

1.1 PRELIMINARY INTRODUCTION

1.1.1 The reason why to choose project

With the passion for aviation as well as passion for technology and equipment related to it, I decided to choose an aviation-related project in this project. Fortunately, my project this time is on the topic of embedded programming. So, I choose a project named "NDB radar detector module using Arduino". In this project, I will rely on the NDB radar to make a small scale NDB radar detector model. So, to get started in this project, we need to know what NDB radar is and how it works.

Recognize the continuous development of aviation technology. I want to add my own knowledge about how a radar system works and a bit of creative idea for this device that came along during I make this project. And that's why I choose this project for myself.

Block diagram

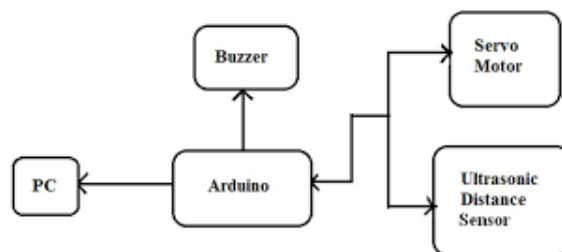


Figure 1.1: Block diagram for radar model

You may ask how the processing application works here. It's very simple, the Ultrasonic sensor collects the object information with the help of Arduino and passes it to processing application, there is a simple Graphics application implemented which mimic a radar screen.

1.1.2 Target Research

The short term goal of this topic is with the desire to learn and supplement the knowledge that in the course of research. With the long term goal, i want to perform the topic in the best way i can. As well as improve the errors of myself. And also, i want to additional the knowledge i haven't learned at my school.

1.1.3 Object and position research

- **Object Research:** The object that i study is the sensor system installed on the air traffic control station or installed on robots that detect objects and avoid them.
- **Position Research:** My reserach is based on the application of radar to detect missing vehicles or to apply air traffic control as call as "Primary Surveillance Radar".

1.1.4 Method of research

- **Observation Method:** By observing directly at air traffic control and also via movies or aviation videos on internet.
- **Method of analysis:** Looking for some similar projects that have been made available online, from the detailed data of those projects, i draw some methods and experience for my project. Avoid mistakes in my project.

1.1.5 Structure Project

My article is divided into three main sessions, summarized as follow:

- In the first chapter, i will focus on brief introduce my project, presenting some of the research content on the topic of the method of conducting research that gives practical results during the project research process.

- The second chapter, is an introduction about some of basic project implementation theories, to present related project i'm working on it.
- Chapter three is the chapter where i introduce the main content of my project, presenting a basic article of project and how it works, accompany it with some examples.
- The next chapter is the construction and circuit design on Kicad Altium software and the implementation of hardware construction.
- And the final chapter is the final section where i draw some conclusion during project implementation, as well as point out my own strengths weaknesses in the course of my project.

1.2 BASIC THEORY

1.2.1 Some research related to the project

Some research ideas related to my project:

- The function contained in some robots, helps robots scan the terrain and detect objects to avoid.
- Radar in the Air traffic control tower named "Primary Surveillance Radar"

1.2.2 Theory concepts related to research issues

- **PSR(Primary Surveillance Radar)**: A Surveillance radar system which uses reflected radio signals.
- **US(Ultrasonic Sensor)**: As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves.
- **PWM(Pulse-Width Modulation)**: is a method of reducing the average power delivered by an electrical signal, by effectively chopping it up into discrete parts.
- **RAM(Random-Access Memory)**: is a form of computer memory that can be read and changed in any order, typically used to store working data and machine code.
- **CPU(Central Processing Unit)**: also called a central processor or main processor, is the electronic circuitry within a computer that executes instruction that make up a computer program.

1.2.3 Components Required

1. For power: Micro USB-B
2. For radar model:
 - (a) Arduino UNO
 - (b) Servo motor
 - (c) Ultrasonic Sensor HRF-04
 - (d) Buzzer
 - (e) LCD 16x02
 - (f) LED (green, red)
 - (g) Test board

1.2.4 Component Description

1.2.4.1 Arduino Uno

1. Introduction about Arduino UNO

Arduino UNO is a microcontroller board developed by Arduino.cc which is open-source electronics platform mainly based on AVR microcontroller ATmega328.

First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartielles and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world.

The current version of Arduino UNO comes with USB interface, 6 analog input pins, 14 I/O(input/output) digital ports that are used to connect with external electronic circuit. Out of 14 I/O ports, 6 pins can be used for PWM output.

It allows the designers to control and sense the external electronic devices in the real world.

Apart from USB, battery or AC to DC adapter can also be used to power the board.

There are many versions of Uno board available. However, Arduino Uno V3 and Arduino Uno are the most official versions that come with ATmega328 8-bit AVR Atmel microcontroller where RAM memory is 32KB.

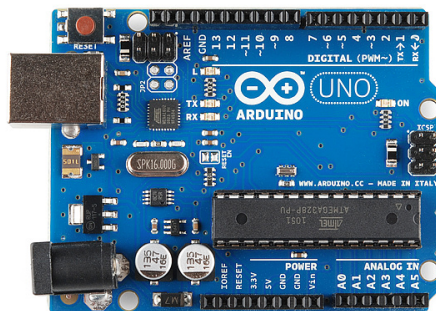


Figure 1.2: Arduino Uno board

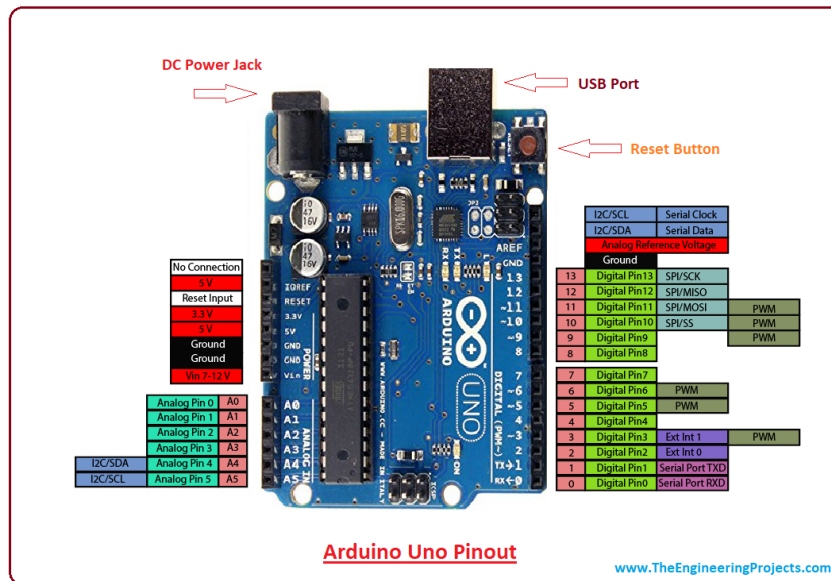
2. Features

- Comes with USB interface.
- USB port is added on the board to develop serial communication with the computer
- ATmega328 microcontroller is placed on the board that comes with a number of features like timers, counters, interrupts, PWM, CPU, I/O pins and based on a 16MHz clock that helps in producing more frequency and number of instruction per cycle.
- It's an open-source platform where anyone can modify and optimize the board based on the number of instructions and task they want to achieve.
- Come with a built-in regulation feature which keeps the voltage under control when the device is connected to the external device.
- There are 14 pins I/O digital and 6 analog pins in the board that allows the external connection with any circuit with the board. These pins provide the flexibility and ease of use to the external devices that can be connected through these pins.
- 6 analog pins are marked as A0 to A5 and come with a resolution of 10bits. These pins measure from 0V to 5V, however, they can be configured to the high range using `analogReference()` function and AREF pin.
- 13KB of flash memory is used to store the number of instructions in the form of code.
- Only 5V is required to turn the board on, which can be achieved directly using USB port or external adopter, however, it can support external power source up to 12V which can be regulated and limit to 5V or 3.3V based on the requirement of the project.

3. Pinout

Arduino Uno is based on AVR microcontroller call ATmega328. This controller comes with 2KB RAM, 32KB of flash memory, 1KB of EEPROM. Arduino board comes with

14 digital pins and 6 analog pins.



4. Pin Description

LED: comes with build-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON and LOW will turn it OFF.

Vin: input voltage provided to the Arduino Uno board. It's different than 5V supplied through the USB port. This pin is used to supply voltage. If a voltage is provided through power jack, it can be accessed through this pin.

5V: comes with the ability to provide voltage regulation. 5V pin is used to provide output regulated voltage. The board is powered up using the 3 ways: USB, Vin pin of the board or DC power jack.