Intelligent Antenna

Design Specification
Version 1.0

R.P.I.T. Somasiri 090498L
S.A.H.B. Surasinghe 09509B
K.H.A. Surendra 09511A
A.L. Abeyweera 090007J

Table of Contents

Table of Figures

PURPOSE OF THE DOCUMENT

The document will cover the design details of the Intelligent Antenna, which is an intelligent antenna rotation system that has the capability to store the directions of the broadcasting stations and rotate the antenna according to the TV channel that has been selected.

SYSTEM ARCHITECTURE

The system basically consists of a stepper motor controlled by a PIC. The abstract architecture of the system can be viewed as follows.

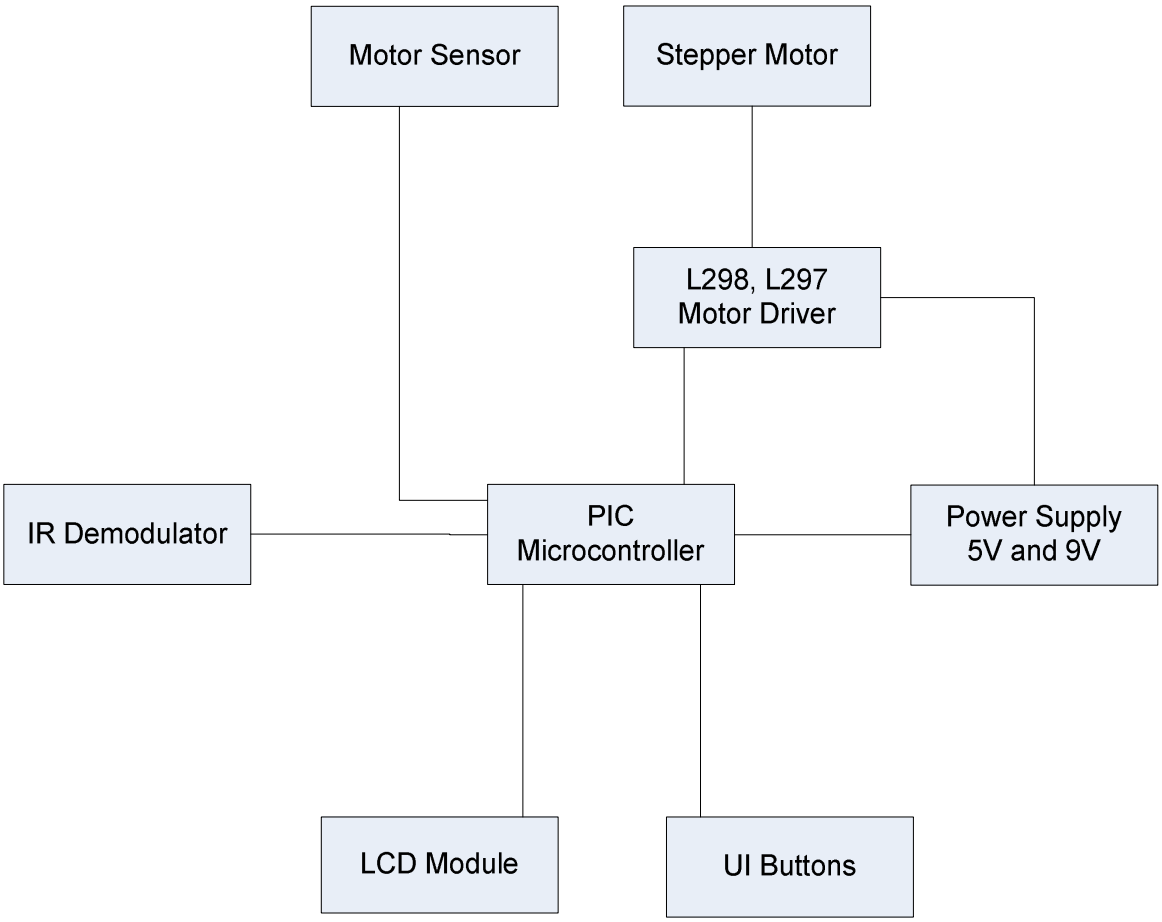

Figure 1: Abstract System Architecture

HARDWARE DESIGN

ELECTRONIC DESIGN

IR DECODER

TSOP1738 IC is used to demodulate modulated IR signal emitted by TV remote. This IC demodulates IR signal, removes carrier frequency and outputs a TTL compatible digital signal. Demodulated digital signal is fed to the Capture module of the microcontroller.

LCD MODULE

5V is used to power up the LCD panel. R/S, R/W, E pins of the LCD module are connected to relevant pins of port E of the microcontroller. Data pins of the module are connected to port D of the microcontroller. Variable voltage between 0-5V is supplied to the contrast pin of the module using a variable resistor.

MOTOR POSITION SENSOR

IR receiver/transmitter module is used to identify the initial position of the rotation at power on. Output from IR receiver is connected to the interrupt pin of the Microcontroller.

STEPPER MOTOR DRIVER

L297 is used as the stepper motor driver. Step clock and direction input is supplied by the microcontroller. L298 IC is used as the power amplifier.

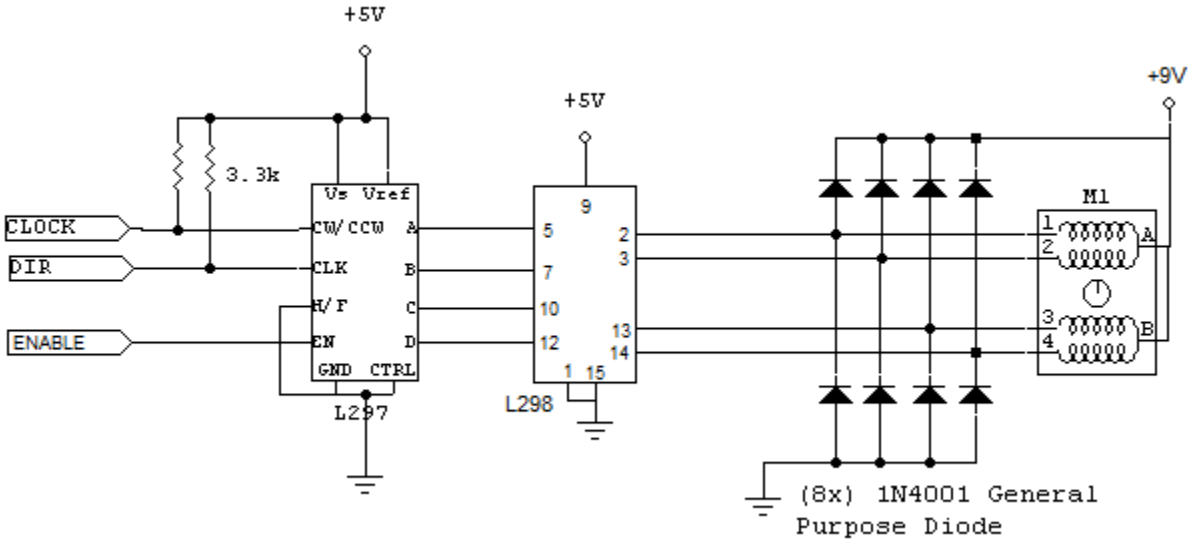

Figure 2: Motor Driver Circuit

POWER SUPPLY

230v to 9v step-down transformer is used to supply main power to the device. Regulated 9v supply is used to power up stepper motors. Regulated 5v supply is used to power up microcontroller and IR demodulator and LCD module.

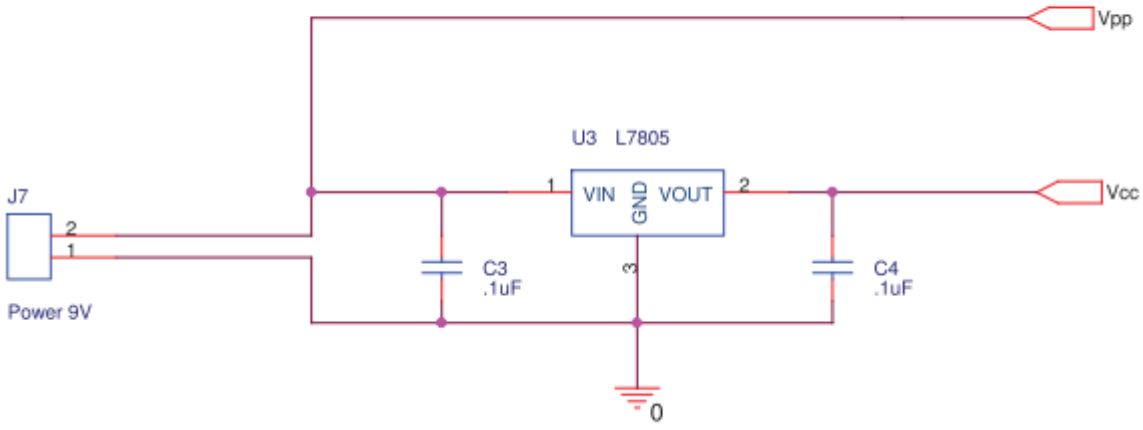

Figure 3: Power Supply

MICROCONTROLLER

PIC18F452 microcontroller is used to control the device operations. This microcontroller is used since it support following peripheral requirements of the device.

- Capture/Compare module – to capture and decode IR signal
- External Interrupt – to get the absolute position of the antenna
- LCD module
- Built-in EEPROM - store channel information

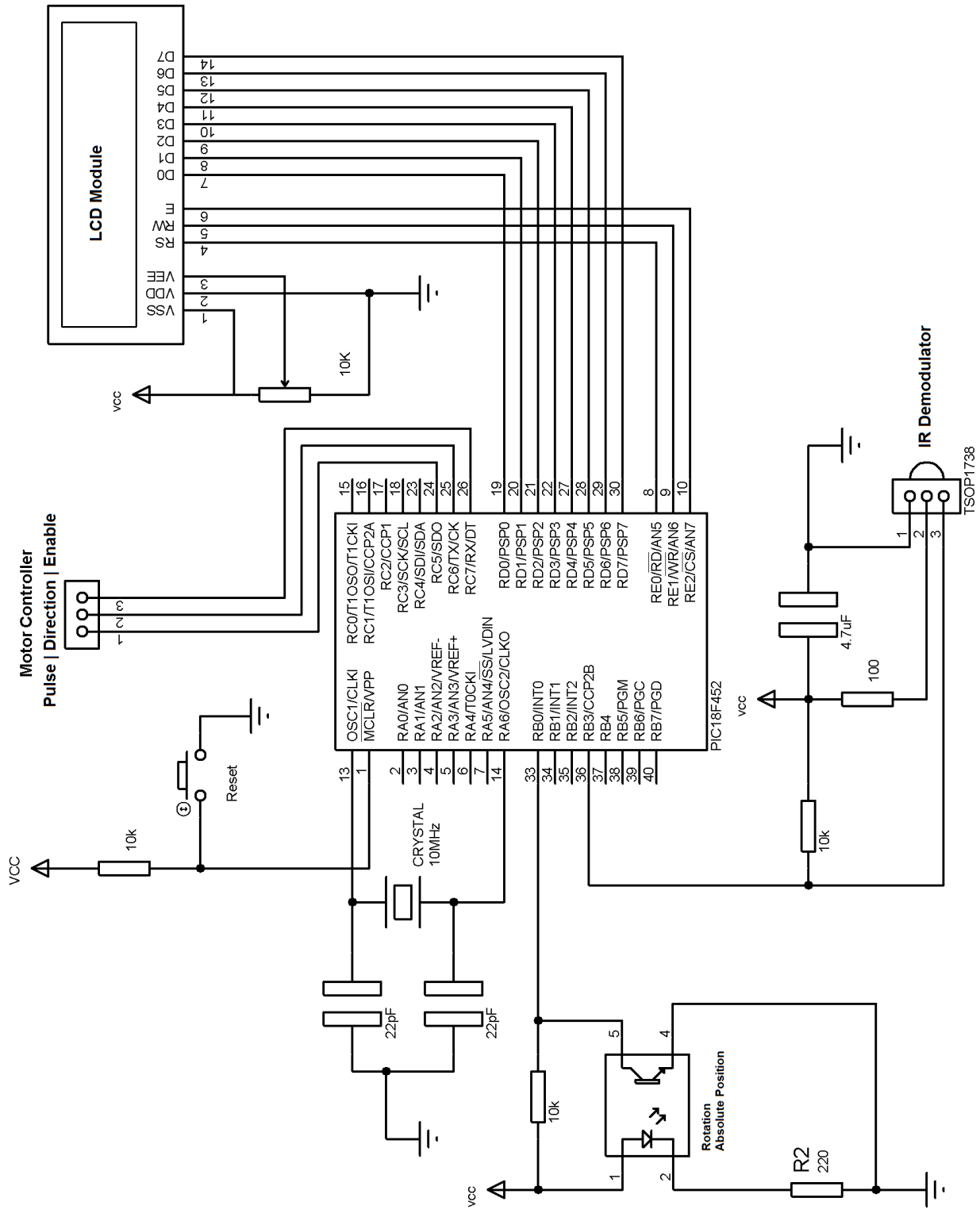

Figure 4:Main Circuit

MECHANICAL DESIGN

CONNECTING THE ANTENNA TO THE SUPPORT

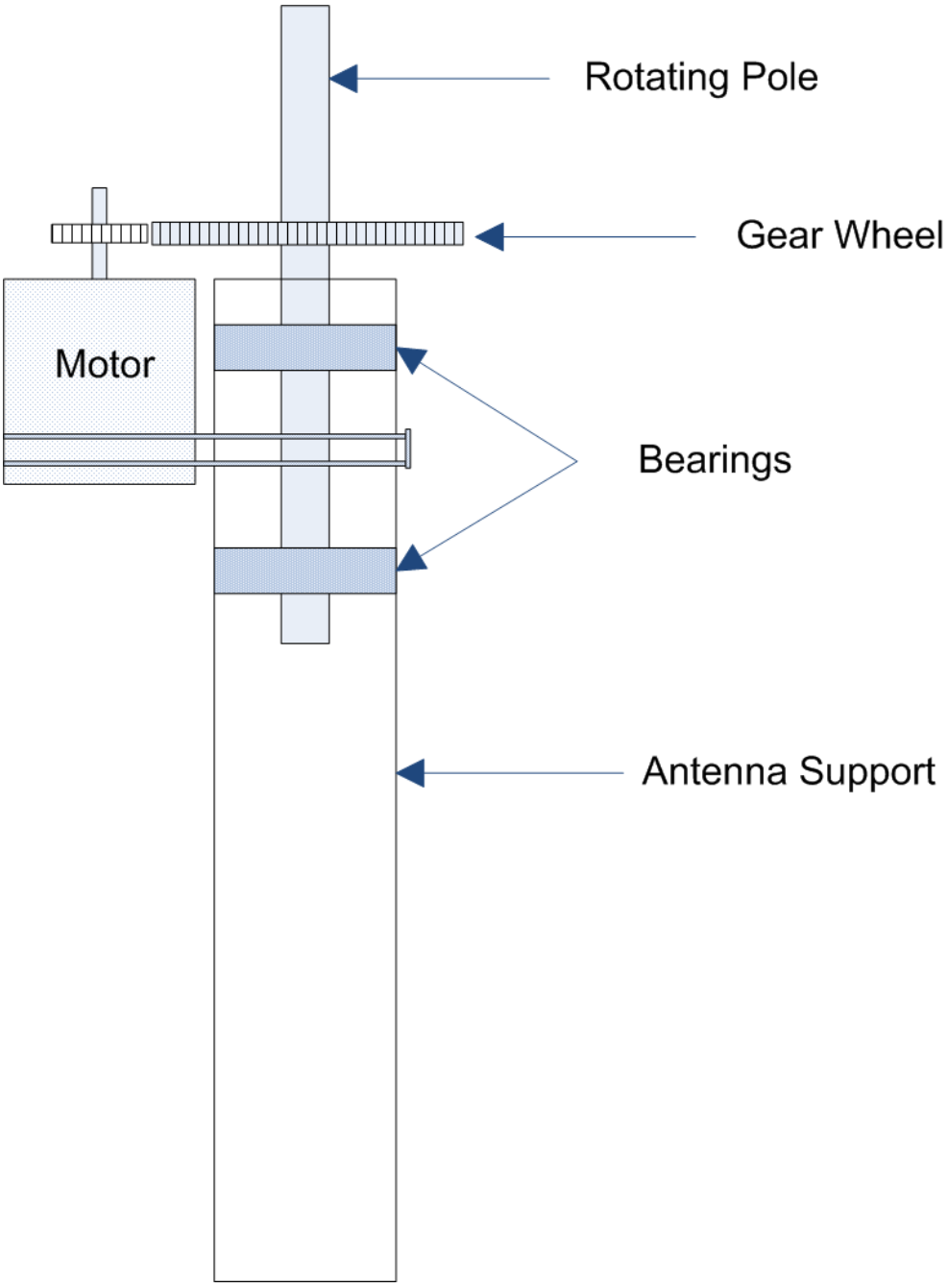

Figure 5: Antenna and Motor Connectivity

The figure shows the mechanical structure that is used to provide the rotating mechanism of the antenna. Antenna Support of the structure is used to fix antenna to the ground. Two bearings are fixed inside the Antenna Support so that the rotating pole which goes through the two bearings can rotate freely. A gear wheel is attached to the pole so that the rotating pole can be rotated using the Motor. The antenna is attached to the top of the structure.

Gear wheels are mainly used for delivering the required torque for rotation. Further it reduces the rotating speed of the antenna which increases the positioning accuracy of the antenna. This will make sure that antenna will rotate the correct position according to the control signals issued by the motor driver circuit. At the same time gear wheels make sure that antenna will not rotate freely due to external torque interferences.

To maintain the transmission between the signals from the antenna system and the control system a slip ring will be used.

DETECTING THE DIRECTION OF THE ANTENNA

An IR emitter-sensor couple will be used to detect an absolute position of the rotation of the antenna.

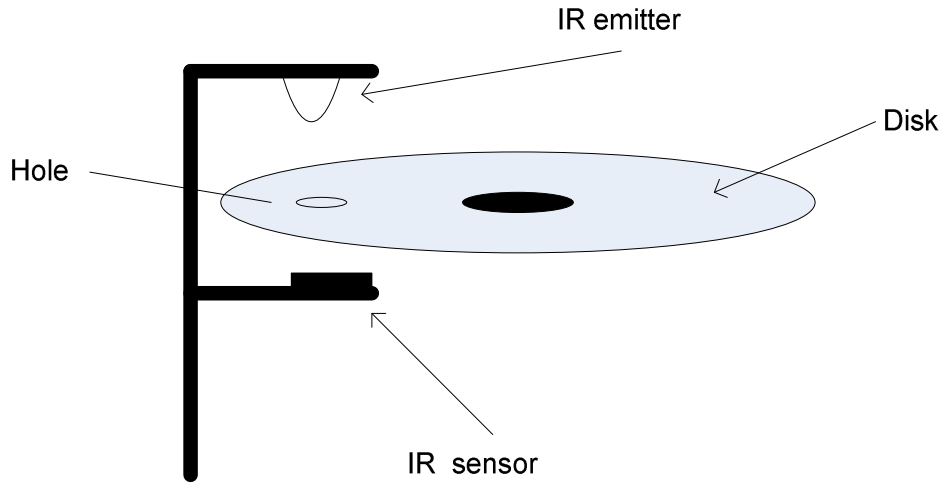

Figure 6: IR Emitter-Sensor Couple

Once the device powers on this can be used to identify the absolute position and other relative positions can be calculated and driven by number of steps of stepper motor. Every time when the antenna completes a 360' angle the hole in the disk will let the IR signal to pass through the disk. So the micro controller can detect the rotation of a full circle and adjust its variables.

SOFTWARE DESIGN

The list of Remote controller manufacturers will be stored in the non-volatile memory (EEPROM) of the micro-processor. Also the number of absolute stepper motor steps for a channel will be stored in the non-volatile area of the PIC.

When the device is turned on the antenna will be rotated to its default position so that the software always knows the antenna's startup position. The default position will be detected using the IR emitter-sensor couple that is located inside the antenna rotation assembly. Also the non-volatile memory area will be used to store the current position of the antenna.

When rotating the antenna, a number will be incremented/decremented according the direction that the antenna is being rotated. This number will indicate where the antenna is with respect to the initial default position. If a change channel signal comes while the antenna is rotating, this number will enable the antenna to decide the direction which it should rotate to.