Report on

STABILITY DRIVEN AUTOMOBILE AUTOMATION

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor Of Engineering

In

Electronics And Telecommunication Engineering

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Academic Year 2016 - 17

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CERTIFICATE

This is to certify that the project entitled **" Stability Driven Automobile Automation "**, has been completed successfully by **Mr.Ajay Khare, Mr.Viki Thakare , Mr.Kaushik Tilve and Mr.Krishna Verma** under the supervision of **Prof. A. M. Ganorkar** is approved for the award of degree of Bachelor of Engineering in Electronics and Telecommunication Engineering from the university of Mumbai year 2016-2017.

Prof. A. M. Ganorkar
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Place.

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Project Report Approval for BE

This is to certify that the project entitled " Gesture Based Wheel Chair Control ", has been completed successfully by **Mr.Ajay Khare, Mr.Viki Thakare , Mr.Kaushik Tilve and Mr.Krishna Verma** is approved for the award of degree of Bachelor of Engineering in Electronics and Telecommunication Engineering from the university of Mumbai year 2016-2017.

Examiner

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2) External................

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Declaration

We declare that this written submission for B.E. project entitled **" STABILITY DRIVEN AUTOMOBILE AUTOMATION "** represents our idea in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly citied or from whom proper permission has nor been taken when needed.

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Abstract

The ever increasing need for vehicular stability never seems to cease. Be it faster automobiles on smoother roads or the slower off-roaders on hilly terrain, one does need maximum levels of stability for smooth operation. A number of accidents occur due to the driver losing control of his vehicle. This may happen due to the unevenness of the road, the texture of the road or simply his loss of focus. The Stability Driven Automobile Automation allows the user to adjust the axel length and wheel base of the vehicle according to the terrain he or she is driving on. This project is aimed to reduce the number of on-road casualties and enhance driving experience through a number of clever automations.

The ability to detect that potentially life-changing moment when your car starts slip-sliding sideways, and then being able to control and correct that slide without panicking and spinning backwards into a ditch full of broken glass, is the kind of thing you'd expect to form part of every road user's driver training. Since the advent of early, basic and, frankly, slightly annoying traction-control systems - which used to cut the power on you at the slightest suggestion of wheel spin - cars have become cunningly adept at keeping us on the road. So much so that grateful governments have made it illegal to sell new cars without stabilitycontrol systems fitted as standard.

Stability control is a full suite of technologies that includes traction control, but also a series of complex programs designed to keep the car both stable and under control - regardless of road conditions or driver ham-fistedness. ii The scissor jack mounted in the center of the axel expands the contracts the outer chassis. The central body mounted on the load bearing beams stays unaffected. The contracted mode provides for a narrower width making it possible for it to squeeze through crowded lanes and propel at higher speeds. The expanded mode allows the vehicle to tread more safely on slipper terrain. This makes it ideal as an off roader. It also proves beneficial for wet roads during monsoons when slipping and skidding of tires is a primary concern and a major cause of accidents.

This project begins with a brief introduction to stability systems and the mechanism used to enhance stability implemented. It contains the details of the literature and scholarly papers referred before attempting this project. It underlines the problem in today's technology by providing point by point explanation of what todays vehicular systems are deficit of. It highlights our work done over the year and shows the procedures we have adopted. It contains our project designs and methodologies we have used to make the Stability Driven Automobile Automation. It highlights the end result at the end and gives a brief conclusion of what we have accomplished in this. It lays emphasis on the future scope giving what more can be added to it over the course of time. Lengthy derivations and embodied inside the appendices and the publications done by the authors and included as well. Finally it concludes with a vote of thanks to all those who made this project possible over the course of its life.

Key words

Scissor Jack, Traction control, Ultra Sonic, RF Transceiver Pair, Chassis

Contents

List of Figures

Chapter 1

Introduction

Aim and Scope:

a. To design an adjustable axel

b. Maintain a low center of gravity for increased stability

c. Smooth conversion between stability modes

d. Installation of ultrasonic sensors for an intuitive and enhanced driving experience

An all-terrain vehicle (ATV), also known as a quad, quad bike, three-wheeler, four-wheeler, or quadricycle as defined by the American National Standards Institute (ANSI) is a vehicle that travels on low-pressure tires, with a seat that is straddled by the operator, along with handlebars for steering control. As the name implies, it is designed to handle a wider variety of terrain than most other vehicles. Although it is a street-legal vehicle in some countries, it is not street-legal within most states and provinces of Australia, the United States or Canada.

By the current ANSI definition, ATVs are intended for use by a single operator, although some companies have developed ATVs intended for use by the operator and one passenger.

These ATVs are referred to as tandem ATVs. The rider sits on and operates these vehicles like a motorcycle, but the extra wheels give more stability at slower speeds. Although equipped with three or four wheels, six-wheel models exist for specialized applications.

The motorcycle chassis consists of the frame, suspension, wheels and brakes. Each of these components is described briefly below. Frame Motorcycles have a frame made of steel, aluminum or an alloy. The frame consists mostly of hollow tubes and serves as a skeleton on which components like the gearbox and engine are mounted.

A chassis consists of an internal vehicle frame that supports an artificial object in its construction and use, can also provide protection for some internal parts. An example of a chassis is the under-part of a motor vehicle, consisting of the frame (on which the body is mounted). If the running gear such as wheels and transmission, and sometimes even the driver's seat, are included, then the assembly is described as a rolling chassis.

The basic idea behind the need for a traction control system is the loss of road grip that compromises steering control and stability of vehicles because of the difference in traction of the drive wheels. Difference in slip may occur due to turning of a vehicle or varying road conditions for different wheels. When a car turns, its outer and inner wheels rotate at different speeds; this is conventionally controlled by using a differential.

The basic idea behind the need for a traction control system is the loss of road grip that compromises steering control and stability of vehicles because of the difference in traction of the drive wheels. Difference in slip may occur due to turning of a vehicle or varying road conditions for different wheels. When a car turns, its outer and inner wheels rotate at different speeds; this is conventionally controlled by using a differential. A further enhancement of the differential is to employ an active differential that can vary the amount of power being delivered to outer and inner wheels as needed. For example, if outward slip is sensed while turning, the active differential may deliver more power to the outer wheel in order to minimize the yaw (essentially the degree to which the front and rear wheels of a 3 car are out of line.)

Active differential, in turn, is controlled by an assembly of electromechanical sensors collaborating with a traction control unit. A further enhancement of the differential is to employ an active differential that can vary the amount of power being delivered to outer and inner wheels as needed. For example, if outward slip is sensed while turning, the active differential may deliver more power to the outer wheel in order to minimize the yaw (essentially the degree to which the front and rear wheels of a car are out of line.) Active differential, in turn, is controlled by an assembly of electromechanical sensors collaborating with a traction control unit. In an electronic device, the chassis consists of a frame or other internal supporting structure on which the circuit boards and other electronics are mounted. In the absence of a metal frame, the chassis refers to the circuit boards and components themselves, not the physical structure. In some designs, such as older sets, the chassis is mounted inside a heavy, rigid cabinet, while in other designs such as modern computer cases, lightweight covers or panels are attached to the chassis. The combination of chassis and outer covering is sometimes called an enclosure.

An axle is a central shaft for a rotating wheel or gear. On wheeled vehicles, the axle may be fixed to the wheels, rotating with them, or fixed to the vehicle, with the wheels rotating around the axle. In the former case, bearings or bushings are provided at the mounting points where the axle is supported. In the latter case, a bearing or bushing sits inside a central hole in the wheel to allow the wheel or gear to rotate around the axle. Sometimes, especially on bicycles, the latter type axle is referred to as a spindle. Axles are an integral component of most practical wheeled vehicles. In a live-axle suspension system, the axles serve to transmit driving torque to the wheel, as well as to maintain the position of the wheels relative to each other and to the vehicle body. The axles in this system must also bear the weight of the vehicle plus any cargo. A non-driving axle, such as the front beam axle in heavy duty trucks 4 and some 2-wheel drive light trucks and vans, will have no shaft, and serves only as a suspension and steering component. Conversely, many front wheel drive cars have a solid rear beam axle.

In other types of suspension systems, the axles serve only to transmit driving torque to the wheels; the position and angle of the wheel hubs is an independent function of the suspension system. This is typical of the independent suspension found on most newer cars and SUV's, and on the front of many light trucks. These systems still have adifferential, but it will not have attached axle housing tubes. It may be attached to the vehicle frame or body, or integral in a transaxle. The axle shafts (usually constant velocitytype) then transmit driving torque to the wheels. Like a full floating axle system, the drive shafts in a front wheel drive independent suspension system do not support any vehicle weight.

Chapter 2

Review of literature

Reichardt, 1961 et al. discusses when an object (defined by a difference in luminance from its surroundings) moves, the motion can be detected by a relatively simple motion sensor designed to detect a change in luminance at one point on the retina and correlate it with a delayed change in luminance at a neighbouring point on the retina. Sensors that work this way have been referred to as Reichardt detectors. [1]

Adelson and Bergen, 1985 et al. say the basic idea behind the energy model is to build spatio-temporal filters which are oriented in space-time and therefore match the oriented space-time structure of moving spatial patterns. This is accomplished by adding together space-time separable filters. A separable filter is one in which the spatial profile remains the same shape over time but is scaled by the value of the temporal filter. For each direction two space-time filters are generated one which is symmetric (bar-like) and one which is asymmetric (edge-like). The sum of the squares of these filters is called the motion energy. The difference in the signal for the two directions is called the opponent energy. However the response of this system will also depend upon contrast and so the result must be divided though by the squared output of another filter which is tuned to static contrast. This gives a phase independent measure which increases with speed but does not reliably give the correct speed value. The model can account for a number of motion phenomenons. [2]

Cavanagh Mather, 1989 et al. debate motion stimuli are classified into firstorder stimuli, in which the moving contour is defined by luminance, and secondorder stimuli in which the moving contour is defined by contrast, texture, flicker or some other quality that does not result in an increase in motion energy in the Fourier spectrum of the stimulus [3]

Ledgeway Smith, 1994 et al. present the motion aftereffect (MAE) -is a visual illusion perceived after watching a moving visual stimulus for about a minute and then looking at stationary stimulus. The stationary stimulus appears to move slightly for about 15 seconds, opposite to the direction of the original (physically moving) stimulus. The motion aftereffect is believed to be the result of motion adaptation. [4]

Eagleman, 2001; Wade Verstraten, 1998 et al. argue motion opponency can be demonstrated by the motion aftereffect in which a static pattern appears to slowly move in the opposite direction to the previously viewed moving stimulus. The motion aftereffect likely results from the adaptation of ortho grade motion detectors; afterward, when viewing a static stimulus, the spontaneous activity of ret-ro grade motion detectors exceeds that of the adapted motion detectors, thereby driving the percept. [5]

Sandia, 2004 said there was nothing in the optics literature to predict that this would happen, National Laboratories researcher Dustin Carr of his group's device, which reflects a bright light from a very small moving object. [6]

Chapter 3

Problem Statement

"To design and develop an efficient flexible axel Stability Driven Automobile and automate driving features."

Slipping is just a type of sliding. Sliding happens when the point of contact of two bodies have different velocities. Skidding is typically associated with winter and its icy conditions. When sliding is in the direction of motion, it is called slipping. In (automotive) vehicle dynamics, slip is the relative motion between a tire and the road surface it is moving on. This is because the force (friction) applied by the brakes on the car wheel can exceed the traction coefficient (friction) of the car tire on the road surface. When the car tire starts to skid, friction with the road is further reduced, so less force is required by the brakes to keep the type locked. It is distinguished from the local sliding velocity of surface particles of wheel and rail, which is called micro-slip.

In the existing system the limitations are:

a. Inflexible axel

b. Higher center of gravity causing decreased stability

c. No conversion between stability modes

d. Absence of ultrasonic sensors for an intuitive and enhanced driving experience

Chapter 4

Work done

4.1 Procedure Adopted

This circuit utilizes the RF module (Tx/Rx) for making a wireless remote, which could be used to drive an output from a distant place. RF module, as the name suggests, uses radio frequency to send signals. These signals are transmitted at a particular frequency and a baud rate. A receiver can receive these signals only if it is configured for that frequency.

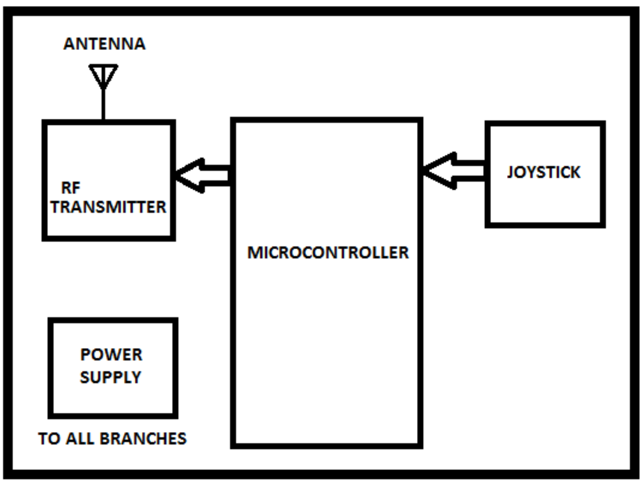

Figure 4.1: Controller Section

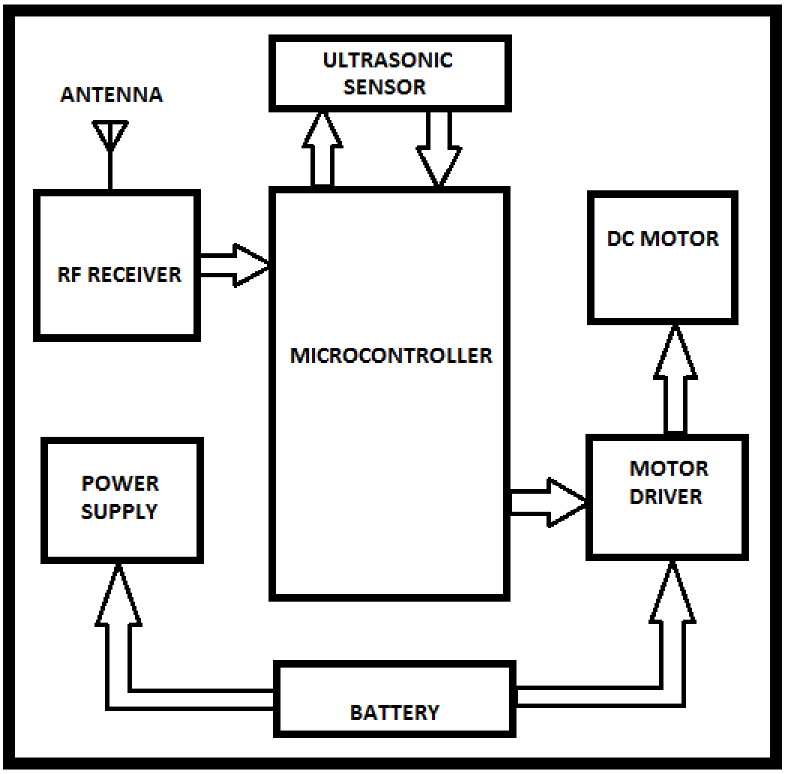

Figure 4.2: Block Diagram of Proposed System

A four channel encoder/decoder pair has also been used in this system. The input signals, at the transmitter side, are taken through four switches while the outputs are monitored on a set of four LEDs corresponding to each input switch. The circuit can be used for designing Remote Appliance Control system.

4.2 Methodology

Working Of a Scissor Jack To Control Axle Length

Figure 4.3: Scissor Jack

There are two main kinds of car jack: those operated by screw and those operated by hydraulics. For standard road vehicles, the screw type is most common, often coming in the form of a scissor jack. Their popularity is a result of their ability to generate a great mechanical advantage – ie a large force amplification from a manually operated arm tool.

These jacks work by using a two-piece mechanism – similar to those found on extending bathroom mirrors – in partnership with a self-locking central screw. 9 Combined, these elements not only enable a vehicle to be lifted through the extension of the scissor mechanism, but also to be held in place by the resistive force of the screw, which without the jack would instantly collapse.

The central screw is also how the jack is operated, with an end-mounted circular ring designed to accept a large Allen key-shaped metal arm. When inserted and turned clockwise this arm drives the screw through the scissor mechanisms central pivot points thread, elongating the jack and, thus, raising the vehicle. In contrast, rotating the screw counter-clockwise unthreads the screw, shortening the jack and, in turn, lowering the car to the ground.

4.3 Design

Circuit diagram consists of three sections namely Control Board, RF Receiver and RF Remote.

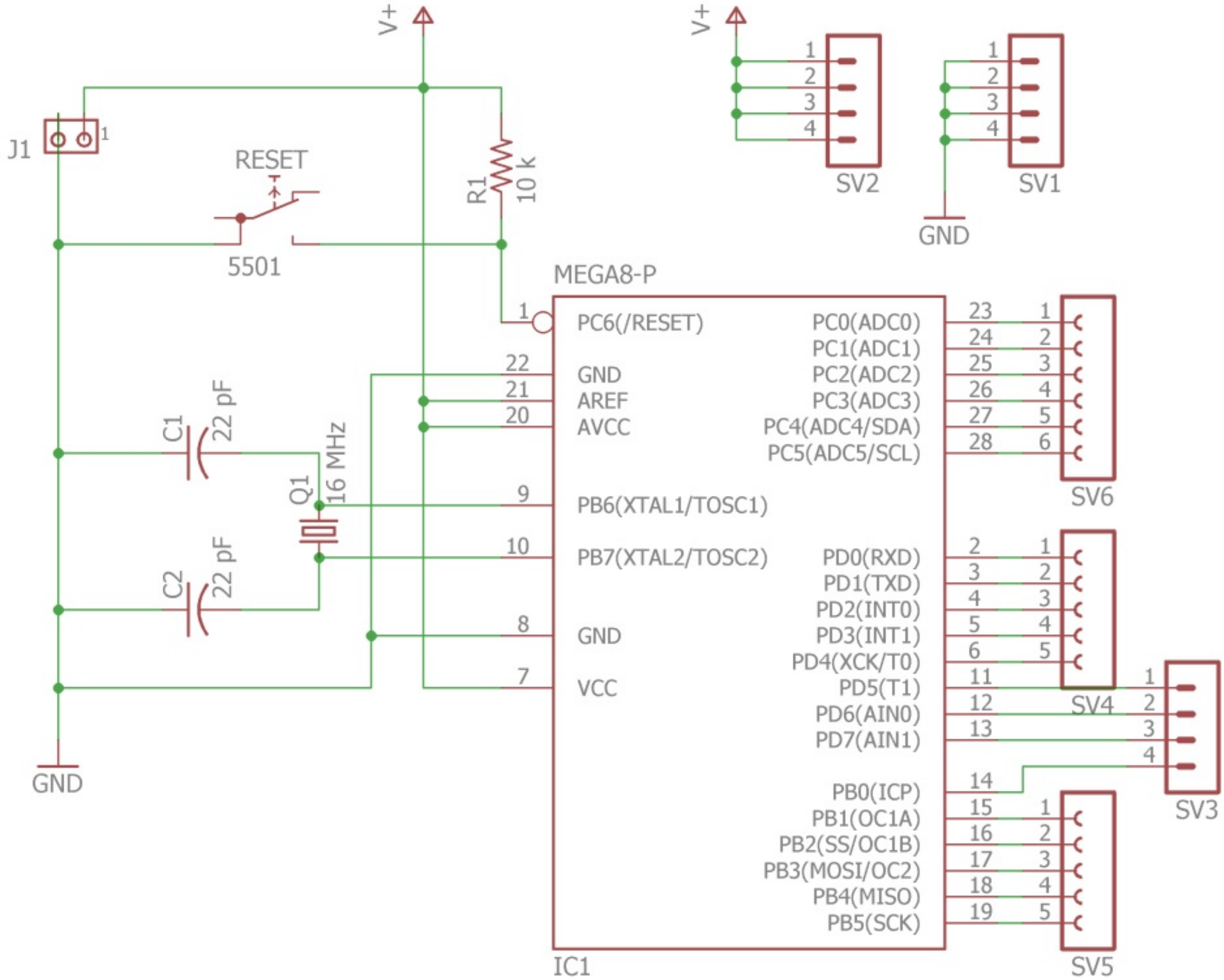

Figure 4.4: Circuit Diagram of Transmitter

Power Supply Circuit: Today almost every electronic device needs a dc supply for its smooth operation and they need to be operated within certain power supply limits. This required dc voltage or dc supply is derived from single phase ac mains. A regulated power supply can convert unregulated an AC (alternating current or voltage) to a constant DC (direct current or voltage).

A regulated power supply is used to ensure that the output remains constant even if the input changes. A regulated DC power supply is also called as a linear power supply, it is an embedded circuit and consists of various blocks. The regulated power supply will accept an AC input and give a constant DC output.

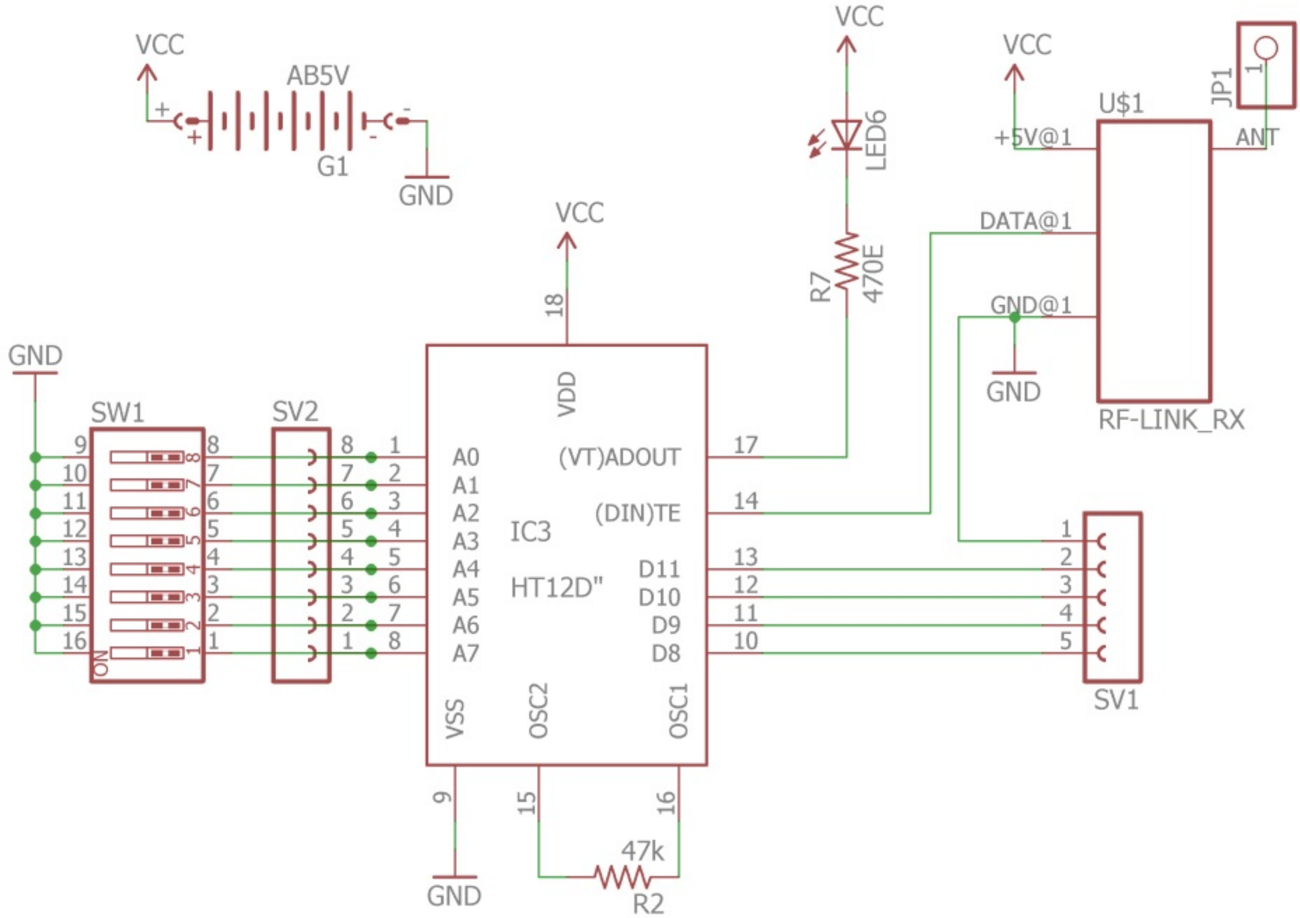

Figure 4.5: Control Board

The basic building blocks of a regulated dc power supply are as follows: 1. A step down transformer 2. A rectifier 3. A DC filter 4. A regulator Step Down Transformer A step down transformer will step down the voltage from the ac mains to the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit. Instead of transformer we can use DC supply. Here we are using 12V/30A DC power supply.

1) Rectification

Rectifier is an electronic circuit consisting of diodes which carries out the rectification process. Rectification is the process of converting an alternating voltage or current into corresponding direct (DC) quantity.

The input to a rectifier is ac whereas its output is unidirectional pulsating dc. Usually a full wave rectifier or a bridge rectifier is used to rectify both the half cycles of the AC supply (full wave rectification). We are using BR1010 Bridge Rectifier which is capable of handling current up to 10 Ampere.

2) Pull-Up resistor:

In electronic logic circuits, a pull-up resistor (R1) is a resistor connected between a signal conductor and a positive power supply voltage to ensure that the signal will be a valid logic level if external devices are disconnected or high-impedance is introduced. In this project pull up resistor is used along with reset button.

4) EN (Enable signal):

When we select the register (Command and Data) and set RW (read - write) now it's time to execute the instruction i.e. the data or command present on Data lines of LCD. This requires an extra voltage push to execute the instruction and EN (enable) signal is used for this purpose.

Usually we make it EN=0 and when we want to execute the instruction we make it high EN=1 for some milliseconds. After this we again make it ground EN=0. Data which we send to LCD can be any alphabet (small or big), digit or ASCII character.

Working at receiver side

This radio frequency (RF) transmission system employs Amplitude Shift Keying (ASK) with transmitter/receiver (Tx/Rx) pair operating at 434 MHz. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission

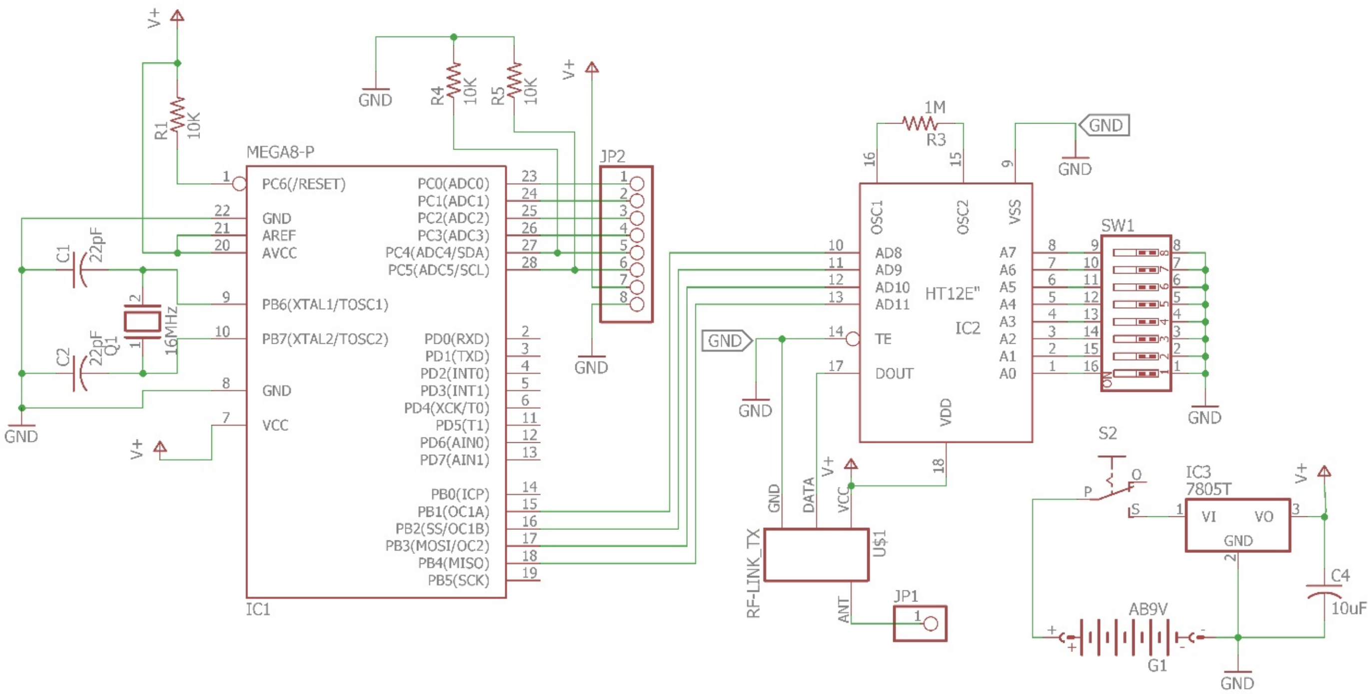

Figure 4.6: RF Receiver

The system allows one way communication between two nodes, namely, transmission and reception. The RF module has been used in conjunction with a set of four channel encoder/decoder ICs. Here HT12E HT12D have been used as encoder and decoder respectively. The encoder converts the parallel inputs (from the remote switches) into serial set of signals. These signals are serially transferred through RF to the reception point. The decoder is used after the RF receiver to decode the serial format and retrieve the original signals as outputs. These outputs can be observed on corresponding LEDs.

Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E.

Transmitter, upon receiving serial data from encoder IC (HT12E), transmits it wirelessly to the RF receiver. The receiver, upon receiving these signals, sends them to the decoder IC (HT12D) through pin2.

The serial data is received at the data pin (DIN, pin14) of HT12D. The decoder then retrieves the original parallel format from the received serial data. Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signals from remote switches along with 8 address bits constitute a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin17 of HT12E.

When no signal is received at data pin of HT12D, it remains in standby mode and consumes very less current (less than 1A) for a voltage of 5V. When signal is received by receiver, it is given to DIN pin (pin14) of HT12D. On reception of signal, oscillator of HT12D gets activated. IC HT12D then decodes the serial data and checks the address bits three times. If these bits match with the local address pins (pins 1-8) of HT12D, then it puts the data bits on its data pins (pins 10-13) and makes the VT pin high. An LED is connected to VT pin (pin17) of the decoder. This LED works as an indicator to indicate a valid transmission. The corresponding output is thus generated at the data pins of decoder IC. A signal is sent by lowering any or all the pins 10-13 of HT12E and corresponding signal is received at receivers end (at HT12D). Address bits are configured by using the by using the first 8 pins of both encoder and decoder ICs. To send a particular signal, address bits must be same at encoder and decoder ICs. By configuring the address bits properly, a single RF transmitter can also be used to control different RF receivers of same frequency.

To summarize, on each transmission, 12 bits of data is transmitted consisting of 8 address bits and 4 data bits. The signal is received at receivers end which is then fed into decoder IC. If address bits get matched, decoder converts it into parallel data and the corresponding data bits get lowered which could be then used to drive the LEDs. The outputs from this system can either be used in negative logic.

Hardware Implementation

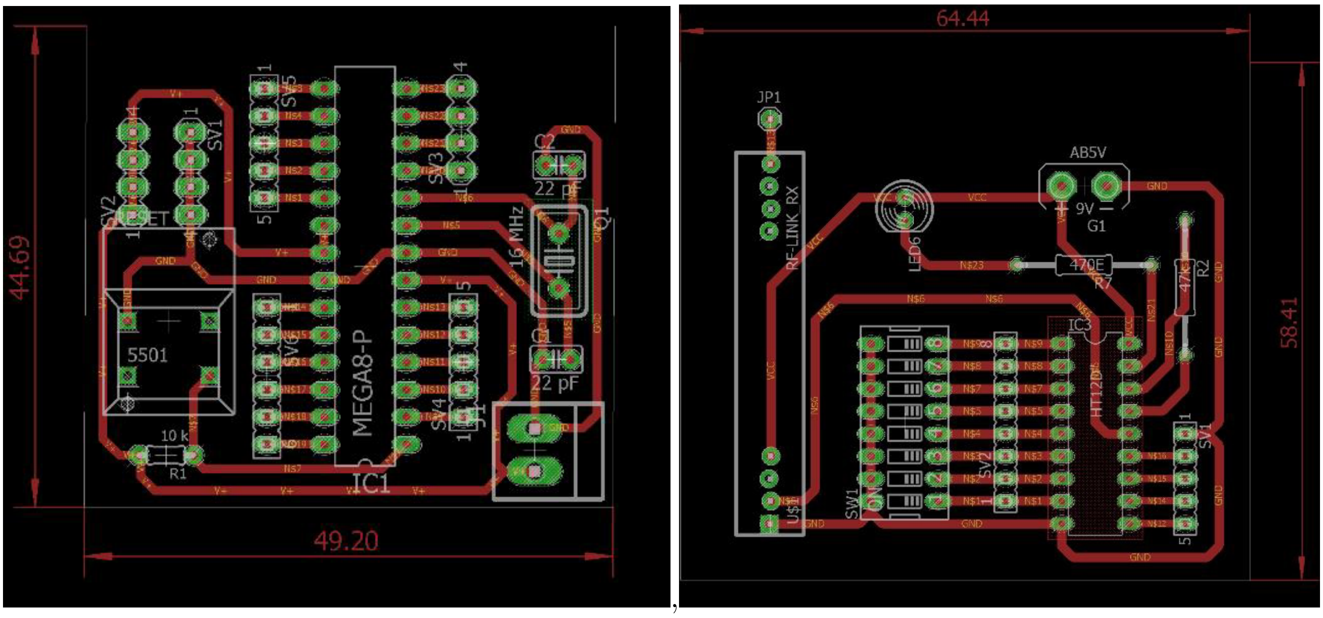

Figure 4.7: TX RX

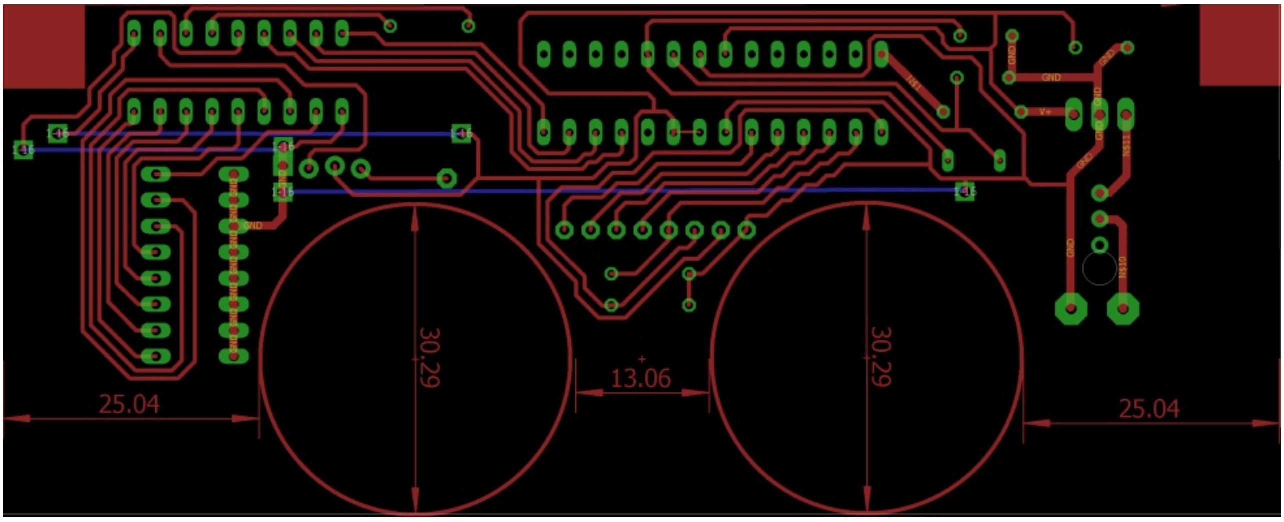

Figure 4.8: Remote Design

Chapter 5

Component Specification

1. Micro-Controller ATMEGA 328P-PU :

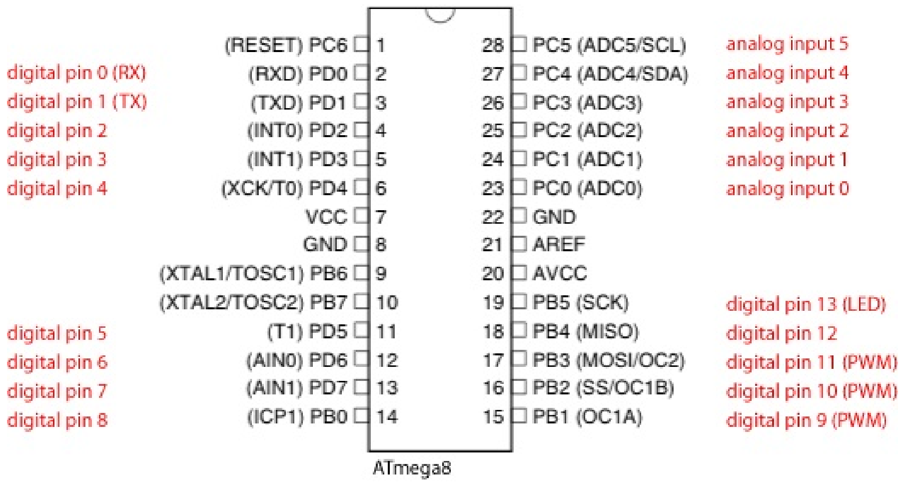

Figure 5.1: ATMEGA 328P-PU

The high-performance Atmel Pico Power 8-bit AVR RISC-based micro-controller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte- oriented 2-wire serial interface, SPI serial port, A 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes.

The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing.

In order to maximize performance and parallelism, the AVR uses a Harvard architecture – with separate memories and buses for program and data. Instructions in the program memory are executed with a single level pipelining. While one instruction is being executed, the next instruction is pre-fetched from the program memory. This concept enables instructions to be executed in every clock cycle. The program memory is In-System Reprogrammable Flash memory. The fast-access Register File contains 32 x 8-bit general purpose working registers with a single clock cycle access time. This allows single-cycle Arithmetic Logic Unit (ALU) operation. In a typical ALU operation, two operands are output from the Register File, the operation is executed, and the result is stored back in the Register File – in one clock cycle.

3. RF MODULE (Tx/Rx):

Radio frequency (RF) is a rate of oscillation in the range of about 3 KHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals.

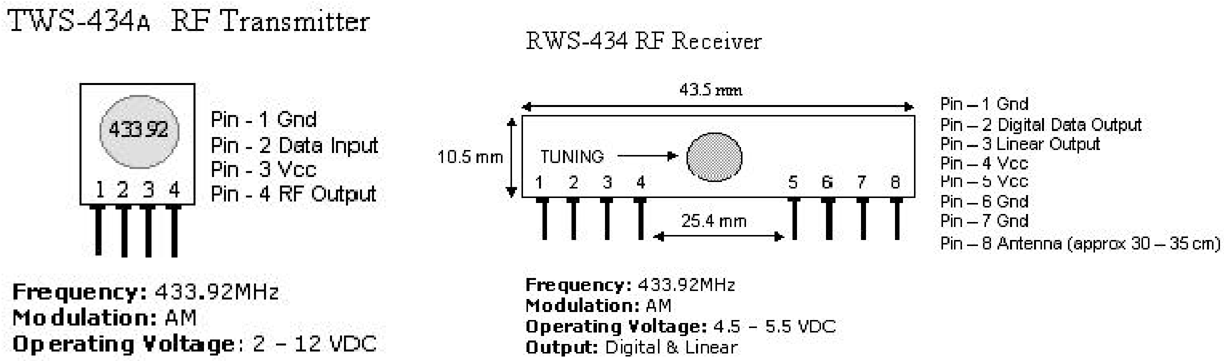

Figure 5.2: RF Module (Tx/Rx)

Although radio frequency is a rate of oscillation, the term ”radio frequency” or its abbreviation ”RF” are also used as a synonym for radio – i.e. to describe the use of wireless communication, as opposed to communication via electric wires. The RF module is working on the frequency of 434MHz and has a range of 50-80 meters.

These modules are indiscriminate and will receive a fair amount of noise. Both the transmitter and receiver work at common frequencies and don't have IDs. Therefore, a method of filtering this noise and pairing transmitter and receiver will be necessary.

4. Ultrasonic Ranging Module HC - SR04)):

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

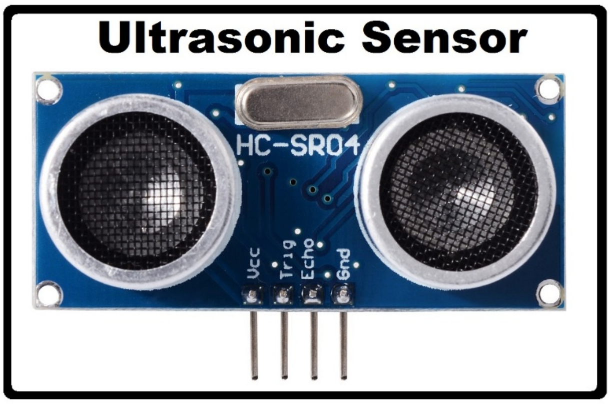

Figure 5.3: Ultrasonic Ranging Module HC - SR04

The basic principle of work:
(1) Using IO trigger for at least 10us high level signal
(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning. Test distance = (high level time * velocity of sound (340M/S) / 2.

You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo.
The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: us / 58 = cm or us / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

Chapter 6

Result

In this system, the road offers a considerable friction making it difficult for expansion on rougher terrains, thereby consuming more power. Having a flexible size chassis would make taxation of vehicle on dimension more complex.

The Stability Driven Automobile Automation allows the user to adjust the axel length and wheel base of the vehicle according to the terrain he or she is driving on. This project is aimed to reduce the number of on-road casualties and enhance driving experience through a number of clever automations.

Chapter 7

Conclusion and Future Scope

The Stability Driven Automobile Automation provides for a one stop solution for solving on-road stability and safety issues. It proves invaluable in reducing millions of annual on-road casualties that result due to vehicles loosing grip of tarmac while in motion. A flexible axel aids in reducing size of vehicle as well making it ideal to zip through lanes and make its way through crowded lanes.

Future Scope

1. Cognitive Autopilot Feature

2. Superior Handling around curves

3. Collision Control

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Chapter 8

Publications

Kaushik Tilve, Krishna Verma, Ajay Khare, Viki Thakare, Ankur Ganorkar, "Stability Driven Automobile Automation" IJETAE Publication in Volume 7, Issue 4, April 2017. (ISSN 2250-2459)

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Appendix I

Ultrasonic Distance Derivation

FOSC=20Mhz
Cycle= 4/20=0.2S
timer count= 0.2*8=1.6S (prescaler=8)
at 20C sound speed = 34000 cm/sec
within 1.6S distance = 1.6*0.000001*34000=0.0544 cm per count
but sound distance is twice (to come an go back)
so relationchip becomes 0.0544/2=0.0272 cm per count

To START the measure ,the device needs a pulse of 10S on trigger input then send (itself) a burst of 8 periodes of 40Khz (so during 200S) then echo output signal goes to 1 status...an return to 0 status when echos is back
Timer1 measure this duration
To avoid to ear the receiver when emitter send the burst salve of 40khz , timer1 start must begin to count after :10+210=210S . so minimum distance (theorical) is :
210*0.0544=5.712 cm (0.0544 because olny one way)

and add a litle offset for calibration here offset is 1.093 cm
(maybe half of the heigh of each sensor * 2)