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Automated Guided *Robo* For Pick and Place Applications (Mobile Robo)

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ABSTRACT

Now a days in this modern scientific world robotics based a vital role play a prodution and process industries.Even thoughthe robot places a vital role in many companies, are not able to install robo in their sectors because of high installation cost and high maintance problem,also a need of skilled person and need to moniter and control it's operation.

Taking this,the robo named as "EIE*robo*"has been designedand controlled by using IC555 in monostable mode & IR sensors.This robo can be operate in linear mode.It can be used in any industries for pick and place robot.And also analysis in MATLAB, the results of EIE ROBO has been proved it's efficiency is better than the existing robo.Similarly it's installation cost when compare found to be less.

EXISTING TECHNOLOGY

1939-1945**:** DuringWorld War II the first mobile robots emerged as a result of technical advances on a number of relatively new research fields like computer science and cybernetics. They were mostly flying bombs. Examples are smart bombs that only detonate within a certain range of the target, the use of guiding systems and radar control. The V1 and V2 rockets had a crude 'autopilot' and automatic detonation systems. They were the predecessors of modern cruise missiles.

1996-1999: NASA sends the Mars Pathfinder with its rover Sojourner to Mars. The rover explores the surface, commanded from earth. Sojourner was equipped with a hazard avoidance system.This enabled Sojourner to autonomously find it's way through unknown martian terrain.

2001: Start of the Swarm-bots project. Swarm bots resemble insect colonies. Typically they consist of a large number of individual simple robots, that can interact with each other and together perform complex tasks. Roombaappears, a domesticautonomous mobile robot that cleans the floor.

2005: The US Department of Defense drops the MDARS-I project, but funds MDARS-E, an autonomous field robot. TALON-Sword, the first commercially available robot with grenade launcher and other integrated weapons options, is released.Honda's Asimo learns to run and climb stairs. In the DARPA Urban Grand Challenge, six vehicles autonomously comple a complex course involving manned vehicles and obstacles.Kiva Systems robots proliferate in distribution operations, these automated shelving units sort themselves according to the popularity of their contents. The Tug becomes a popular means for hospitals to move large cabinets of stock from place to place, while the Speci-Minder with Motivity begins carrying blood and other patient samples from nurses stations to various labs. Seekur, the first widely available, non-military outdoor service robot, pulls a 3-ton vehicle across a parking lot,drives autonomously indoors and begins learning how to navigate itself outside. Meanwhile, Patrolbot learns to follow people and detect doors that are ajar.

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2010: TheMulti Autonomous Ground-robotic International Challenge has teams of autonomous vehicles map a large dynamic urban environment, identify and track humans and avoid hostile objects

Note: *Gregory Ducdeck, Michael Jenkin, Computational Principles of MobileRobotics, Cambridge University Press, 2000 (Chapters 1 and part of 2)

*H. R. Everet, Sensors for Mobile Robots-Theory and Applications.

*Phillip McKerrow,Introduction to Robotics, AddisonWesley, 1991 (Chapter 1).

*Ronald Arkin, Behavior Based Robotics, MIT Press, 1998 (Chapter 1)

PROPOSED TECHNOLOGY

Mobile Robotics

Introduction of Robot

Since their introduction in factories in 1961, robots have evolved to achieve more and moreelaborate tasks. The industrial robots now account for a 5 billion dollars market. Positionedalong the assembly line, a robotic manipulator can perform tedious and repetitive tasks suchas welding, painting, moving or cutting with immense speed and incredible accuracy.

As anexample, their use in the automotive industry has drastically cut the time it takes toassemble a vehicle.Since the introduction of the first industrial robot UNIMATE online in a General Motorsautomobile factory in New Jersey in 1961, robots have gained stronger and strongerfoothold in the industry. Several milestones are worth noting since then the first controlled by a computer was designed. The RanchoArm was designed as a tool for the handicapped and its six joints gave it the flexibility of ahuman arm.But it at best describes industrial robots and applications – not all robotic applications areassociated with “move things”. “Programmed motions” may have to be augmented formobile robots that often decide their motion part based on their situational awareness. Amore inspiring and general definition can be found in Webster. According to Webster arobot is:”An automatic device that performs functions normally ascribed to humans or a machine inthe form of a human.”

The Webster definition broadly covers robotic tasks and functions beyond moving things asin RIA definition. Being a subset of robots, one may consider that defining mobile robotwould be easier and more accurate. Indeed, Wikipedia has this definition:”A Mobile Robot is an automatic machine that is capable of movement in a givenenvironment.”

Concepts

- Robotics
  Scientific area that studies the link between Perception and Action
- Robot
  Device able to perform activities as a human .Programmable manipulator able to execute multiple operations (e.g.,material and part handling), following programmed paths to fulfill a largevariety of tasks.
- Mobile Robot / Mobile Platform
  Platform with a large mobility within its environment (air, land, underwater)

  A system with the following functional characteristics:

  - Mobility: Total mobility relative to the environment
  - A certain level of autonomy: Limited human interaction
  - Perception ability: Sensing and reacting in the environment

The terms Mobile Robot, Mobile Platform, Vehicle, Robot are often used with the same meaning

Applications

1. Areas of application (ctn):Material Handling
2. AGVs, SGVs, LGVsSafety
3. Surveillance of large areas, buildings, airports, car parking lotsCivil Transportation Inspection of airplanes, rains,Elderly and Handicapped
4. Assistance to handicapped or elderly people, helping in tansportation, health care
5. Entertainment
6. RobotDog
7. Aibo – Robot dog from Sony

Inspection of airplanes, rains,Elderly and Handicapped

Real Application Examples

Figure 1: AGV for rack handling

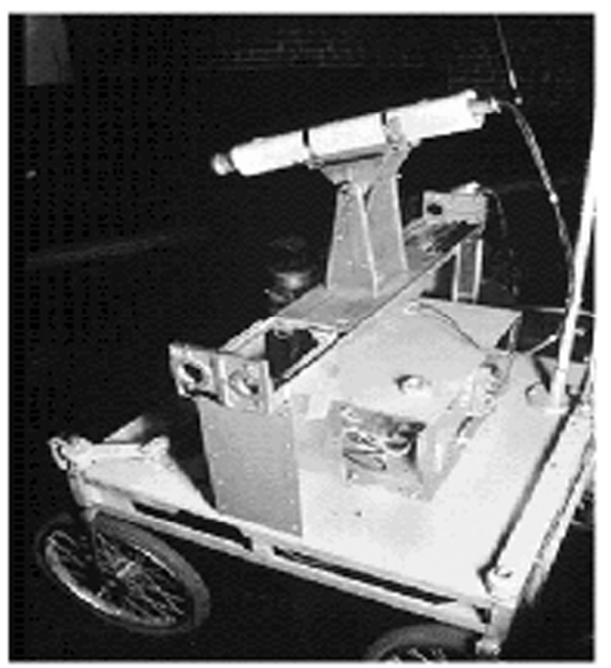

Figure 2: 1979- Stanford Cart

Design Method

In this project the IR sensor is used to sense the wheel of the robo and operate it by sending the signal to the IC555, (the robo use the IC555 in monstable mode because in this IC can operate at 2 levels, when it get pulse signal and go to another state and again come back when ever the signal again obtained) .So in the pulse signal the IR sensor is given to the IC it create the one output signal and that signal send to the base of the transistor (BC547), it act as switch and the emitter isgrounded,collecter is connected with the coil of the relay.when ever the signal given to the IC by IR sensors the output of is given to the transistor and the switch is closed and relay chance from N/C to N/O,then the motor can operate and the start operating.In following paragraphs explain the construction details and function of the IC555 circuit.

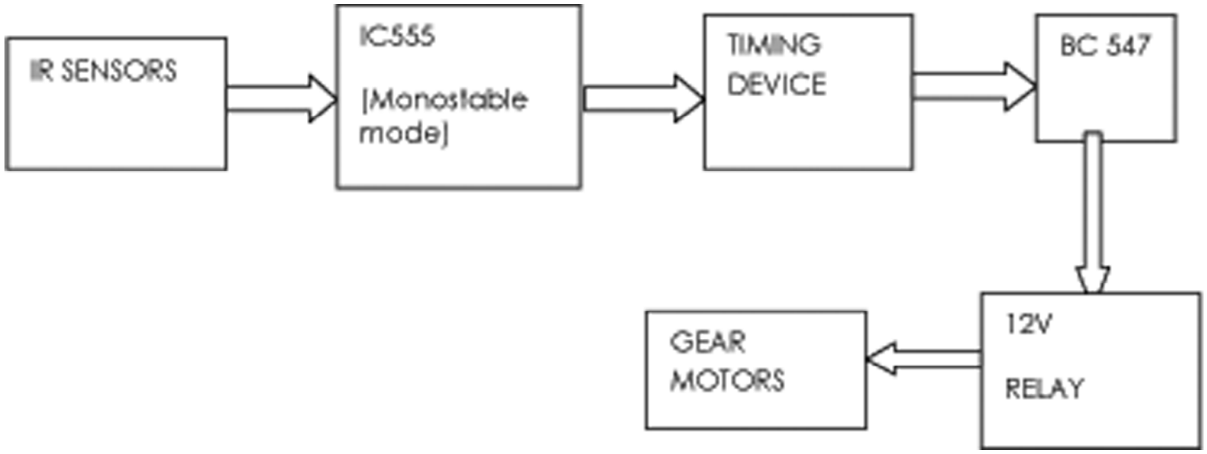

Figure 3: Block diagram of the working model

The 555 timer is so named because its primary mode of operation is intended to be in monostable mode. Operating as a monostable, it does not fit the strict definition of an oscillator because, unlike true oscillators, it requires an input signal to trigger its operation, however the fact that the 555 timer can be used in both monostable and astable mode considerably increases its flexibility and usefulness

Monstable Operation**:** Unlike the astable, which has two unstable states and so continually switches from one to the other and back again, the monstable has one stable state and one unstable state. When triggered by a suitable pulse at its input (pin 2) it switches from its stable state, in which the output is low, to its unstable state where its output is high. This state exists for a time controlled by the values of R_1 and C_1, and at the end of this period the output switches back to its stable (low) state. Its primary use is therefore to produce a set time delay, initiated by an input pulse.

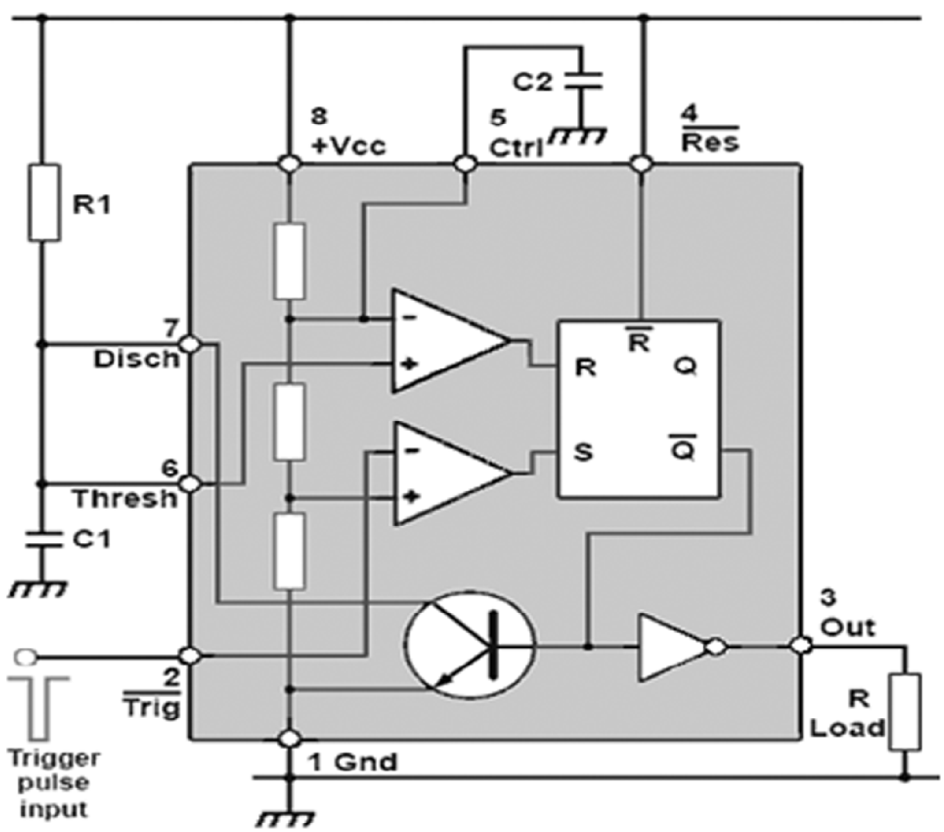

Figure 4: Monstable Waveforms

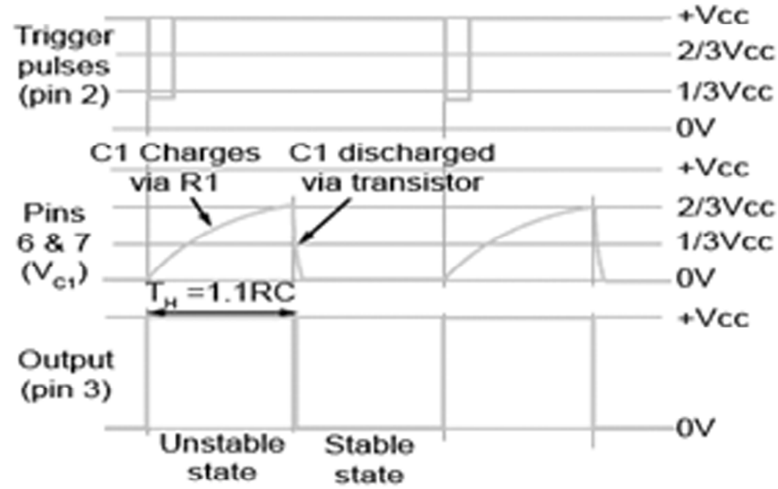

Figure 5: The 555 Monostable

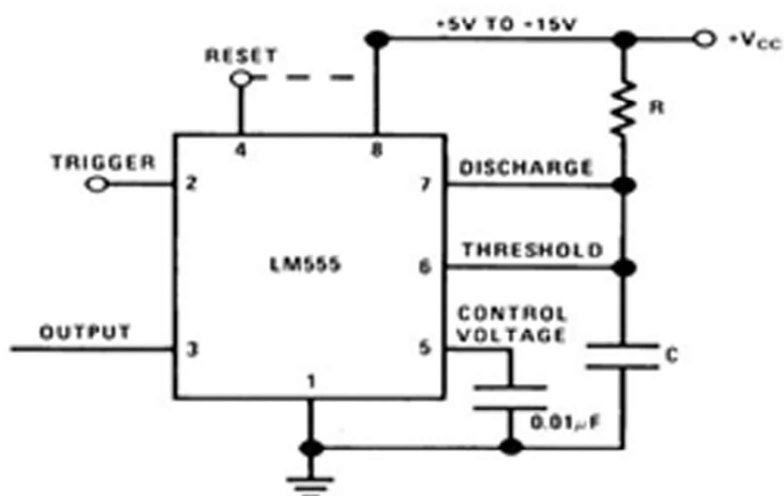

Figure 6: 555 Monstable Circuit

From Fig (5) it can be seen that the circuit differs from the basic astable configuration shown in oscillators module 4.3 in that only one timing resistor (R_1) is used, pins 6 and 7 (instead of 6 and 2) are connected together and pin 2 is used for the trigger pulse input.

Fig (6) illustrates the timing waveforms for the monostable, notice that the trigger pulse on pin 2, which must be higher than 1/3Vcc in the absence of a trigger pulse but normally at about +Vcc, falls to less than 1/3 Vcc to trigger the start of the delay (high output) period.

TIMING COMPONENTS

In monstable mode the timing of signal (time for generate and receive the signal) based on the timing components.So in that lets explain about that, only one resistor and one capacitor are involved in the timing process, and as the capacitor charges from 0V to 2/3Vcc in 1.1 time constants, from the information on capacitor time constants,, a capacitor will charge in an exponential fashion to 63.2% of its full charge voltage (+Vcc) in one time constant, so to reach 2/3Vcc (66.7%) will take 1.1 time constants. The delay period (T) is the time taken for the timing capacitor to charge to this level and so can be simply calculated as

As the point at which the capacitor begins to discharge in a fraction (2/3) of Vcc, due to the internal resistor chain in the 555, waveform timing is unaffected by changes in the supply voltage. The trigger pulse

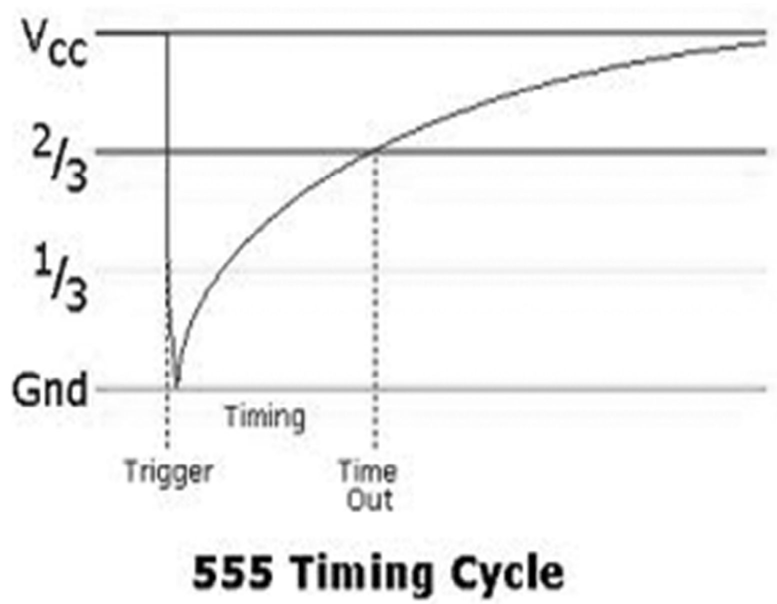

Figure 7: Timing Diagram

makes the voltage on the inverting input of comparator 2 lower than its non-inverting input and so the comparator output goes high, making the S input of the bistable high and setting the bistable Q output high, and its Q (not Q) output low. This turns off the discharge transistor and the low output from the bistable is inverted by the inverter to make the output at pin 3 high.C_1 commences charging from 0V towards +Vcc, but once V_{C1} reaches the discharge level of 2/3Vcc, Comparator 1 is triggered, the bistable is reset, the output at pin 3 goes low and the discharge transistor immediately discharges C_1. As C_1 is also connected to the non-inverting input of comparator 2, this voltage also falls, and as the trigger voltage on pin 2 is now high again after the trigger pulse, the 1/3Vcc threshold level that was active in the astable configuration is ignored as V_{C1} falls and C_1 is fully discharged to 0V. No further action takes place until the arrival of a further trigger pulse at pin 2, and during this time the monostable is said to be in its stable state.Fig(3) shows a schematic diagram for a basic 555 monostable circuit with an output pulse duration of just over 1 second. Because this circuit is not working at high frequencies, the supply decoupling capacitors C3 and C4 may be considered as optional, but nevertheless it is good practice to make sure the circuit is not affected by external noise by decoupling the 555 supply with a 100nF capacitor (to remove high frequency noise) and an electrolytic of around 2 μF (to remove low frequency noise). Both of these capacitors should be fitted as physically close to the 555 IC as possible.

CHOOSING A TIMING CAPACITOR:

And also the 555 monostable can generate delays from a few microseconds to several hours depending on the values of $R_1$and C_1. However, using very large capacitor values can be a problem, since large value electrolytic capacitors have quite wide tolerance limits, so their actual value may not be the same as their value markings by a significant amount. They also have high leakage currents and this can affect the timing accuracy as the capacitor charges. When large capacitance values must be used, tantalum capacitors can be a better choice due to their lower leakage current. High working voltage electrolytic capacitors should also be avoided where possible as electrolytic do not function properly as capacitors when operated at voltages less than about 10% of their rated working voltage. For example, using an electrolytic capacitor rated at 100V in a 555 circuit operating on a 5V supply could also

TRIGGER PULSES

To trigger the 555, pin 2 must momentarily go to less than 1/3Vcc, the duration of the trigger pulse must not be longer than that of the output pulse, and with short output periods or long duration input (trigger) pulses,

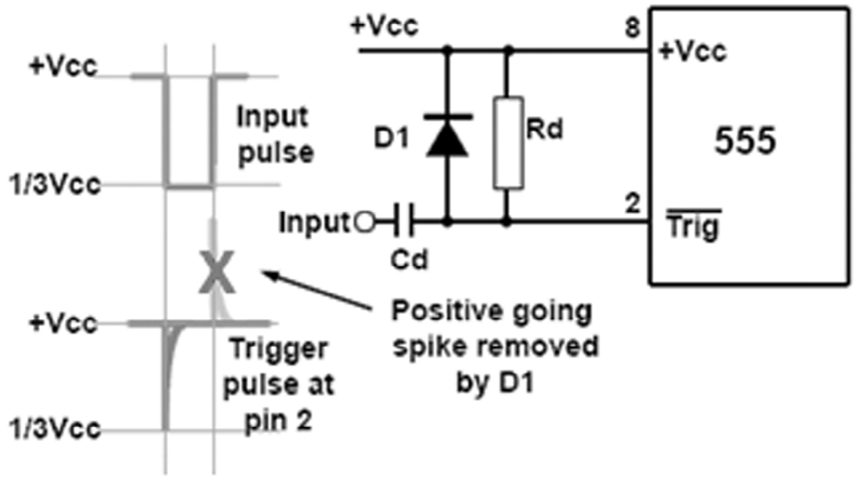

Figure 8: Differentiating 555 Trigger Pulses

some conditioning of the trigger pulse may be needed to keep its duration short. A common method is to differentiate the trigger pulse to produce a very narrow negative going spike at the falling edge of the pulse as shown in Fig (5).The differentiator Cd and Rd produces two spikes symmetrical about +Vcc, but as spikes going more positive than +Vcc will not play any part in triggering the 555 and would additionally contribute to unwanted noise in the circuit, they are removed by D_1, which will prevent any voltages higher than +Vcc appearing at pin 2.The result is a much narrower trigger pulse, the duration of which will depend on the values of R_d and C_d. The values of these components are not critical provided that $R_d$does not load the input too much and reduce the amplitude of the trigger pulse, and that the resulting duration of the trigger pulse (at 1/3Vcc) is less than the duration of the output pulse. The output pulse ends when the voltage on the capacitor equals 2/3 of the supply voltage. The output pulse width can be lengthened or shortened to the need of the specific application by adjusting the values of R and C.The output pulse width of time *t*, which is the time it takes to charge C to 2/3 of the supply voltage, is given by

$$t = RC \ln(3) \approx 1.1\, RC$$

Where t is in seconds, R is in ohms (resistance) and C is in farads (capacitance).While using the timer IC in monostable mode, the main disadvantage is that the time span between any two triggering pulses must be greater than the RC time constant. In monostable mode the 555 timer outputs have high pulse, which begins when the trigger pin is set low (less than 1/3Vcc, as explained in the previous step, this is enough to switch the output of the comparator connected to the trigger pin). The duration of this pulse is dependent on the values of the resistor R and capacitor C in the image above. When the trigger pin is high, it causes the discharge pin (pin 7) to drain all charge off the capacitor (C in the image above). This makes the voltage across the capacitor (and the voltage of pin 6) = 0. When the trigger pin gets flipped low, the discharge pin is no longer able to drain current, this causes charge to build up on the capacitor according to the equation below. Once the voltage across the capacitor (the voltage of pin 6) equals 2/3 of the supply voltage (again, as explained in the previous step, this is enough to switch the output of the comparator connected to pin 6), the output of the 555 is driven back low. The output remains low until the trigger pin is pulsed low again, restarting the process just described.

$$\text{(Voltage across Capacitor)} = Vcc * (1- e^{-t/(R*C)})$$

this equation describes the time it takes to charge a capacitor of capacitance C when it is in series with a resistor of resistance R as explained above, and interested in the time it takes for the voltage across the capacitor to equal 2/3Vcc

$$2/3*Vcc = Vcc * (1- e^{\wedge -t/(R*C)})$$

which can be rearranged to:

$$2/3 = 1- e^{-t / (R*C)}$$
$$e^{-t / (R*C)} = 1/3$$
$$-t / (R*C) = \ln(1/3)$$
$$t = 1.1*R*C \text{ seconds}$$

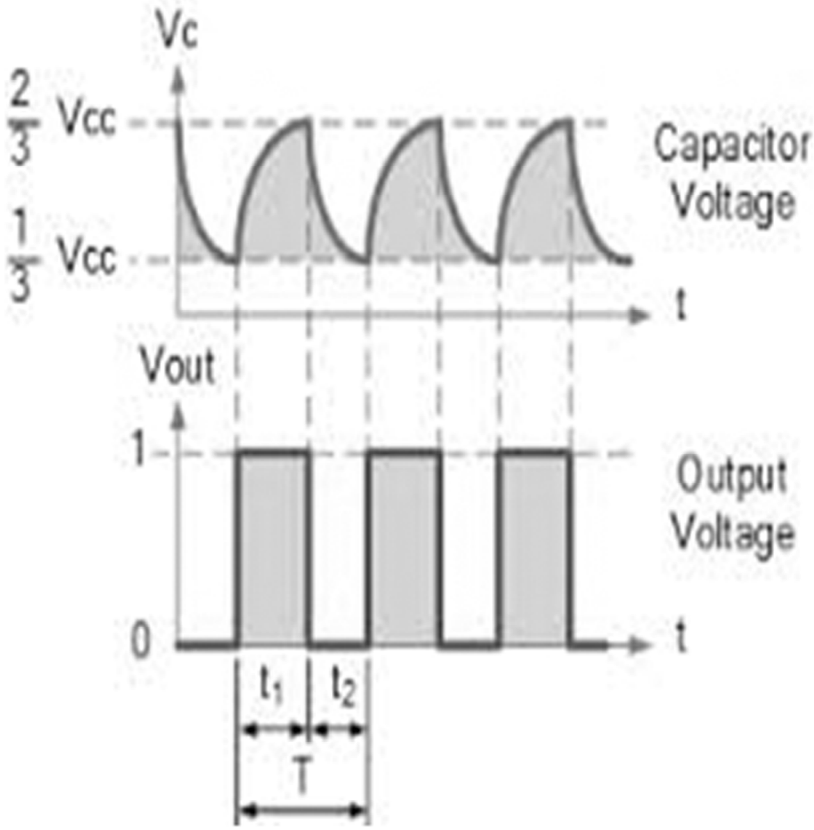

Figure 9: Output responce

In the next step connect an indicator LED to the output pin of the 555 and pick some arbitrary values for R and C to make sure that this really works.

MECHANICAL DESIGN

Mobility: Mobility in mobile robots requires mechanical frame and motivational parts. Another consideration is to give the mobile robot locomotion capabilities based on its deployment environment and missions. If the robot will only encounter smooth ground, wheels or tracks would be reasonable. Rougher terrain would require bigger wheels. So the robo have the plastic wheel attached with 10rpm gear motors.

Sensors: A large collection of sensors are available to detect information about the environment. They can be used for monitoring purposes (chemical sensors, ir,re sensors etc..)or to help the robot to maintain its operations So in this robo use the ir sensors.

Actuators: They allow the robots to perform extra tasks besides mobility.

WORKING

The output from the 3rd pin of IC555 can connected with the base of BC547 transistor and the emitter is grounded, the collector is connected with the coil of relay whenever the trigger can be given to the IC555 by the via of IR sensor (which sensing the wheel) .Then the obtain output voltage from IC is given to the

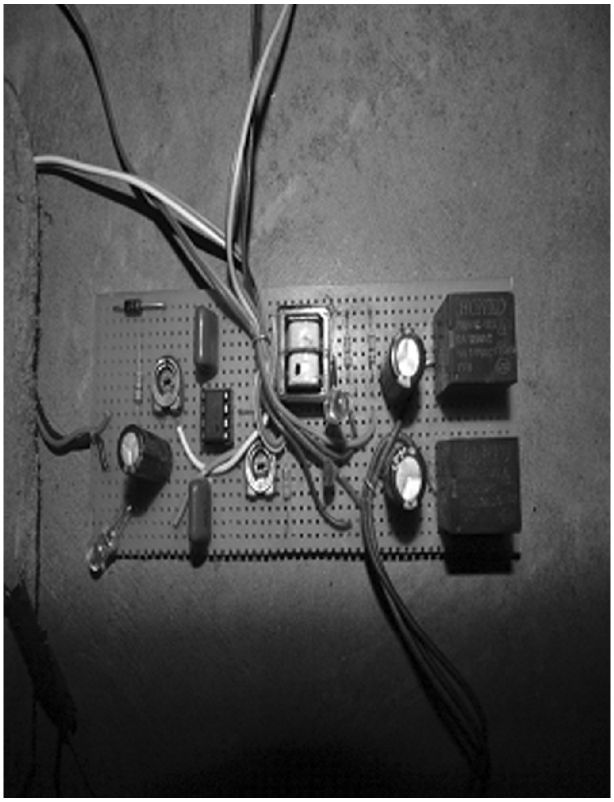

Figure 10: Circuit of the working model

Figure 11: Working model

transistor and it can be act as a switch.So the supply pass through the coil of the relay and relay contact change from N/C toN/O. Now the gear motor can operate opposite direction and the robo change its linear movement (e.g: right side to left side) shown in fig: (10) & fig: (11)

RESULT

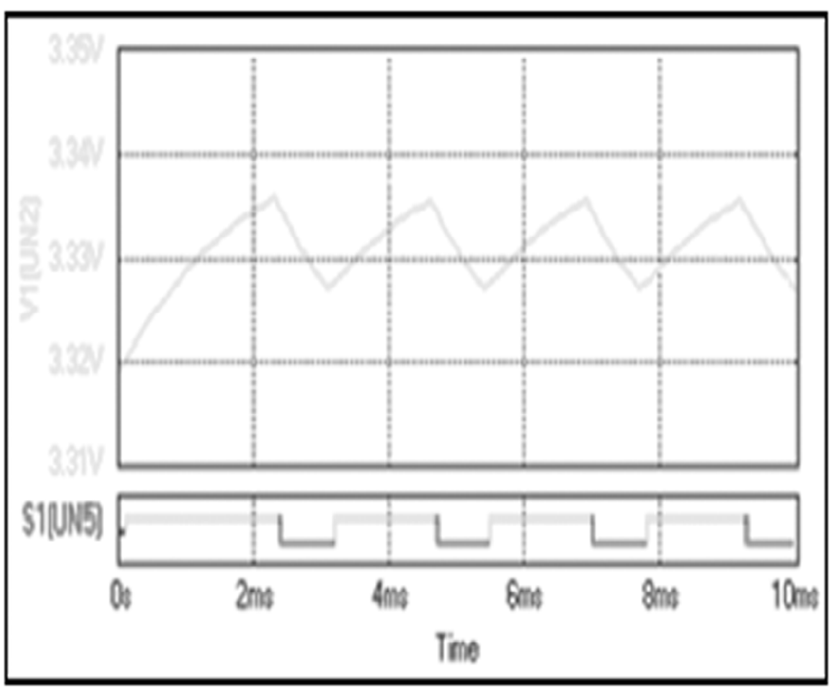

Figure 12: Performance analysis of the circuit

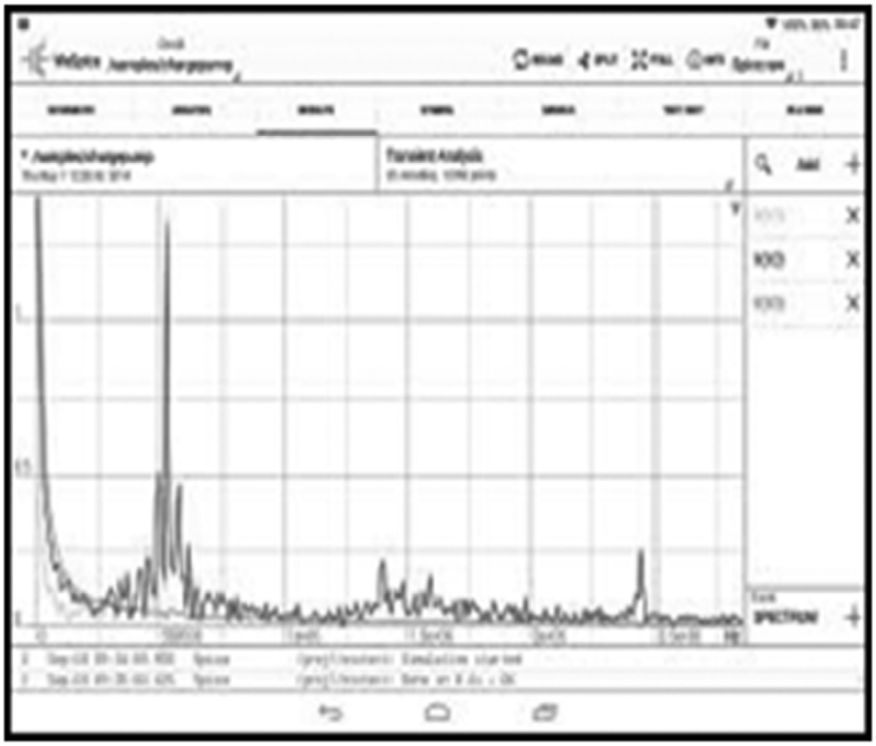

Figure 13: IR signal analysis

After this analysis, finally the result of the project is, the robo can performed better than normal programmed robots and it can lift the things and carry it to the another place with safe manner .And also it can be suitable for industry in both cost & performance wise compare with other robo (that have more initial cost & and complex programming),this robo also have 4axis rotation hand for pick and place the things .

And also the robo there is no way to malfunction because I not feed any program and no use any microcontroller. (So it not have any self thinking but it can work as like the exciting mobile robo)

The difference between the exciting robo to this robo, it is not have any memory (not self thinking)&not have any controller and programming, but it is a major advance to the robo because it not malfunctioning at anytime and also easy to manufacture, the robo have the gear motor with 10rpm to move in around the industry, it have 5feet height so it can work like a people and suitable for the modern science world.

CONCLUSIONS

As opposed to fix based industrial robots, a mobile robot has its movement unlimited by its physical size due to its mobility. As a result, this robots can operate in a large workspace and explore unknown environments and therefore are able to perform tasks wherever needed. It have been used to perform a variety functions that are normally performed by humans or a machine in the form of human, such as surveillance, exploration, patrol, homeland security, domestics helper (e.g. lawn mower), butler, care taker, and entertainer.

The recent decade has witnessed an explosion of research activities in mobile robotics. Because of the need to operate in unknown and/or uncertain environments, mobile robots demand much higher level intelligence than traditional industrial robots. These requirements have been met by the phenomenal advancement in this project (mobile robo using IC555 &IR sensor). So the robo can be useful for *small scale industries for pick and place the things in around that industry in desired path*.