Automatic Land surveillance System by Sketching Robot

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***Abstract* :**
This Paper is about an automatic sketching robot. This robot can be used make sketches of the lands or plots .The operator need to run the robot along the boundary to get the Trace of the land. The robot will output the distance travelled in straightly and angle turned in turns. From this inputs the software can sketch the trace of the land.

Keywords — *sketching robot, Matlab, MPLAB*

I. INTRODUCTION

Land needs to be measured for various reasons like prior to purchase, when doing stock taking, building a boundary wall, dispute with a neighbour over demarcation, etc. Measuring regular land area like residential plots sold by real estate agents and land developers is easy as they have mostly rectangle or other geometrical shapes. Recalling geometry studied in High School we can do the measurements and arrive at the results. But if the area of land is highly irregularly shaped or if you are purchasing large tracts of land like a farm measuring miles across, then how do you do the measurements?

A. Geometric Method

In this method the odd shaped plot is surveyed and plotted over graph paper. The area of the plot is then subdivided into geometric figures whose area we can calculate by formulae. First the largest size geometric figure that can be neatly be drawn in the map is made, followed by smaller shapes, until the complete space has been occupied more or less. All these figures have their areas calculated, which are then added together to give the total area.

B. Using Planimeter on Map

A small device called planimeter is used for measuring areas of a graphically represented planar region. The planimeter can measure all regular and irregular shapes. All you have to do is to pivot it at any point and then run the end pin all over the perimeter of the area you want to measure. It has got a flexible linkage which allows it to move without any effort in all directions. But using a planimeter is only useful if you have a map of the area or an aerial photograph. Nowadays you can get high resolution photos by satellites by using Google earth, Wikimedia, and other applications. You can also draw your own map after you have taken the dimensions and angles of the various lines and afterwards measure it using a planimeter

C. Dividing into Geometric Shapes

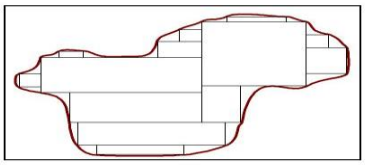


Fig.1 : Geometric Shape Procedure and Planimeter

D. By Using Measuring Wheel

A measuring wheel is another method of measuring the area. In principle it is like a planimeter that you have to go over the perimeter of the area with it, only you have to do it on the actual land. Built like a single bicycle wheel, it has to be run all over the edges of the land to be measured and it gives the reading

E. Using GPS

GPS stands for global positioning system and consists of sets of satellites that give your coordinates when you use a hand held receiver. It gives your position coordinates with an accuracy of within 1 meter. This is very useful in large land areas where you can go to each end and note the coordinates and later calculate the area.

F. Using Aerial Photographs

The aerial photographs of the land areas can also be used for the measurement by using a planimeter or by graph paper using suitable scale. The aerial photographs are very useful in land surveys. This is very useful if the land has visible markings or can be seen properly or having contrast. Like in the figure given below the farmed lands can be differentiated from the non-farmed land areas.

II. EXISTING SYSTEM

Today land sketching need to be done manually. it is a waste of time and need more efficient way to draw sketches. Robots are used in many fields of the world. the shape drawing robot and positioning robots technology are very useful for our project. following are very helpful papers for as

A. Positioning of a Mobile Robot Based on Odometry and a New Ultrasonic LPS

Odometry is a method that calculates the position and heading angle of a mobile robot using encoders attached to the wheels of the robot. Errors in the position and heading angle in odometry continuously increase as the operating time and moving distance increase. An ultrasonic local positioning system (LPS) consists of multiple ultrasonic transmitters located in the environment and an ultrasonic receiver. In this study, ultrasonic transmitters are in a line at one side, and four transmitters are grouped for a coverage area. In order to measure the time of flights (TOFs) for an ultrasonic signal, the receiver predicted the transmitted time from each transmitter using a hyperbolic model. The proposed system provides reliable and accurate position and heading information, regardless of the operating time and moving distance.

1) Odometry System

A rotor encoder is a system that converts the angular rate of a rotor into a digital signal. Generally, rotor encoders are attached to the wheels of a mobile robot, and the angular rate of the wheel is measured by the encoder. The rotor encoder generates N pulses while the wheel rotates by 360°. If the measured pulses are M counts, the angular rate of each wheel becomes counts, the angular rate of each wheel becomes

ηLK=. (ML/N)*2*pi

ηRK=. (MR/N)*2*pi

where ηLK and ηRK are the angular rates of the left and right wheels in radians, respectively. ML and MR are the measured pulses of the left and right encoders. The velocity, position, and heading angle of the mobile robot are estimated by the angular rate of each wheel Fig. 1 shows the movement prediction of the mobile robot from the angular rate of each wheel. The mobile robot's travel distance can be expressed in terms of its wheel radius Wheel and angular rate of each wheel as follows:

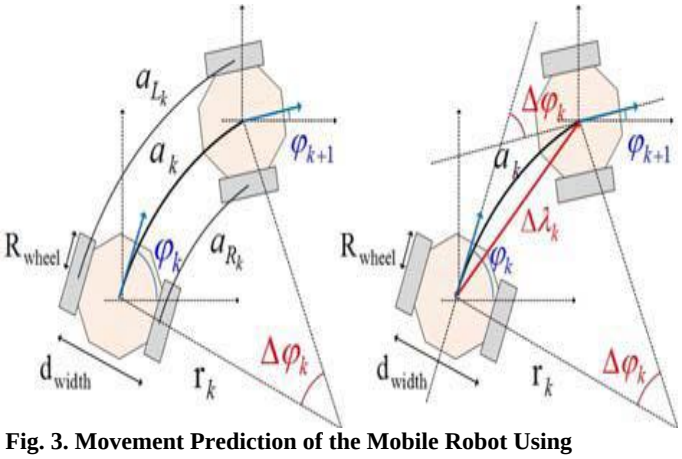


Fig. 3. Movement Prediction of the Mobile Robot Using Rotary Angles.

al,k=(ML/N) circumferance of LEFT wheel

ar,k=(MR /N) ⍰ circumferance of RIGHT wheel

a,k=(al,k+ ar,k)/2

al,k and ar,k are travelled distance of left, right wheel respectively. The heading angle rate of the mobile robot is calculated using the width of the robot, width and the distance traveled by each wheel

Δ Ǿk=(al,k- ar,k)d,width

Where Δ Ǿk is in radian. The rotation radius of the mobile robot is given as follows:

rk= a,k/ ΔǾk

2) Ultrasonic Lps

This section proposes a new ultrasonic LPS, where the transmitters are installed at one side of the space. Traditional ultrasonic LPSs are limited by many problems. We suggest an alternative for these limitations and explain the method for position estimation by proposed method. There are four methods for ultrasonic signal detection: thresholding, curve fitting, M-out-of-N sliding window, and correlation detection. Thresholding is simple; however, this method has a bias error and is weak in regard to external noise. Curve fitting reduces the bias error considerably. The sliding window reduces the bias error and is robust to external noise.Correlation detection is the most robust method to external noise among these methods. Moreover,

this method maximizes the SNR, but it has more complex computations. Each transmitter is installed with height h and width w inline on one side of the space where the mobile robot is travelling. Four transmitters compose the group for a coverage area, and each transmitter can be extended endlessly with IDx

The transmitters cannot transmit simultaneously because the ultrasonic signals have constructive and Here, we use a method in which the transmitters transmit a 40-kHz carrier signal that is modulated by A predefined 4-bit code signal. After the ID1 transmitter transmits a coded signal, each transmitter works sequentially every 100 ms in a cyclical order: ID2, 3, 4, 1, 2, destructive interference. Therefore, the transmitters use a scanning method where each transmitter works sequentially. For this reason, the receiver must distinguish each transmitter.

*3) **Design of a USB Based Multichannel, Low Cost Data Acquisition System Using Pic Microcontroller***

This paper describes the design and development of a low cost Data Acquisition System (DAS) using PIC18LF4553 microcontroller for real time data acquisition. The designed DAS has 4 analog input channels having 12-bit resolution and was interfaced through the USB port of the PC. The interface to the PC is basically a USB based virtual serial port emulation using FT232R, a USB to serial UART interfacing IC. The PIC microcontroller firmware has been written in C language and compiled using Micro compiler for PIC and downloaded to the microcontroller by using USB Burn programmer for PIC. A PC application program has been also developed using MATLAB, which allows displaying the waveform of the signal(s) in real time and storing the data into the hard disk of the computer for future use and analysis.

With the rapid development in the field of embedded technology there is also an increasing thrust for a data acquisition system which is fast in processing speed, small in size, low in cost and monitors the data in real time basis. The use of a microcontroller as a processor has become popular because of its speed, energy efficiency, low cost and low weight, which leads to the broad use of it in Data Acquisition System (DAS). Data Acquisition System is a system which is used for acquisition of signals of physical parameters continuously for a certain period of time and keeps a record of those acquired values for future use.

A typical DAS has a primary control and data processor, memory and a clock /calendar module for time stamping the acquired data. A number of sensor attachments depending on the applications are also necessary. As most of the internal processors are digital in nature, hence the analog signals are often converted to digital format before being used for processing. For analysis, display and recording, the processor is further connected with computer or Laptops.

III.PROPOSED SYSTEM

Our system mainly have a software and hardware. The software is a matlab application which can run in a pc or lap and the hardware is a robot and its interface. The robot mainly used to get the trace of the land. The robot need to be control manually. Robot is simply a 3 wheel (2 in rear,1 in front) moving structure. It use differential steering to rotate. Both rear wheels have separate rotor encoders for measuring the rpm. Rotor encoder is a disk having many holes. But Here we use the moving wheel as rotor encoder. In which a IR transmitter receiver pair is used. The IR will reflect from the wheel or transmit through the holes of wheel. When the wheel is rotating it will output specific number of pulses .

By measuring the pulses we can find the passed distance. The pic in the robot will count the pulses. The pic will frame the pulses . It will count till a another moving instruction came. The heading angle is measured by counting both wheels and the calculation is done by matlab software. The heading angle in radian is the ratio between difference in left and right wheel traveled distance to the width of robot. After a turning it can clear the memory and start a new edges counting. Using the frame header matlab can understand whether the frame represent a length or angle. The pic used here is PIC16F84A. which is 20 pin comparatively small but enough for our requirements. since the robot uses rounded wheels having rubber surfaces it have difficulties to travel through rough surfaces. But using flying things like quad copter it much more comfortable.

In that type data acquisition will be complex.Since measuring large areas we need strong communication. So we use a RF module hardware for that. We use RF communication here. Radio spectrum is from 3Hz to 3Thz. We use two half duplex RF module for communication. Since the RF module need to interact directly to microcontroller it must be noise free.We use a computer interface. There we use The same PIC16F84A. And which will convert the serial data coming from Tx pin of serial adapter to 4 bit parallel data which will given to the RF module .

RF module will encode it and transmit to the robot for controlling the motors. The interface will also do the necessary error check. We need to interface robot to computer interface. Which can done by many ways by using rs232 ports, usb port, etc. but nowadays usb ports are more common but it's protocol is much more complex. So we use a usb

to serial adapter for getting rs232 port from a usb port. And the pic will read data from serial adapter and given to the rf module. The commands from matlab will be for controlling the motors and data given to matlab will be measured values.

Block Diagram

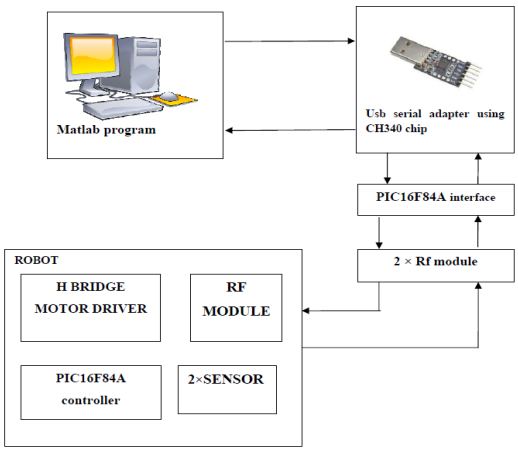


Fig. 4. Block Diagram

Block Diagram Description

The main components of the project are shown on the block diagram. The robot mainly have a PIC16F84A microcontroller. The microcontroller responsible for counting the rotor encoder output pulses. And this pulses need to transmit to the computer. H bridge drivers using bjt is used to drive the two motors. Robot use differential steering to turn. Their need separate sensors for 2 wheels. The sensors used are IR obstacle sensors which is immune to sun's IR noise. We use 2 half duplex RF modules for communication between robot and computer interface .

Here we use a computer interface which consist mainly a pic. And which will convert the serial data coming from Tx pin of serial adapter to 4 bit parallel data which will given to the rf module . rf module will encode it and transmit to the robot for controlling the motors. The interface will also do the necessary error check.

Usb serial adapter used to get the serial port from usb port. The data is given to the matlab. The serial object created in matlab can used to read and write binary values. In matlab it will first make the sketch of the land and then fill it with pixels to find the area. Matlab will read the data from the pic and by using frame header it can understand is the data represent a length or angle. If the MSB is 1 it treat as length and if 0 it treat as angle. Angle will be calculated by dividing the difference in traveled distance between left and right wheels to the robot width.

Flow chart of Matlab Program

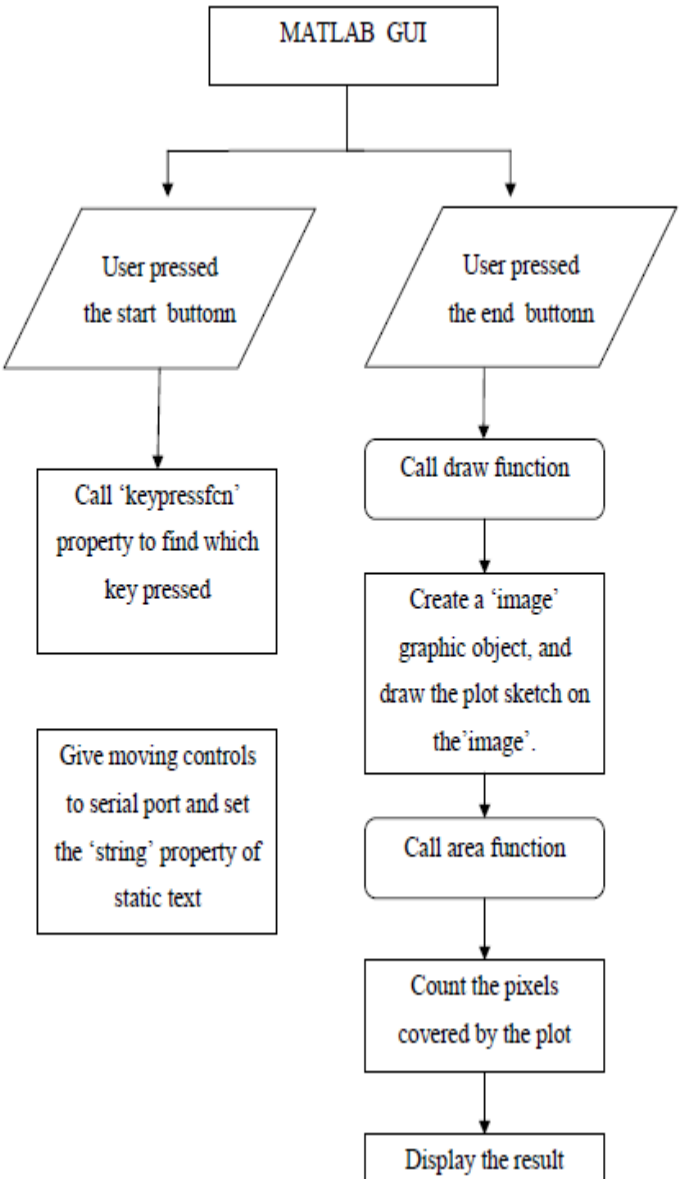


Fig. 5. Flow Chart of MATLAB Programm

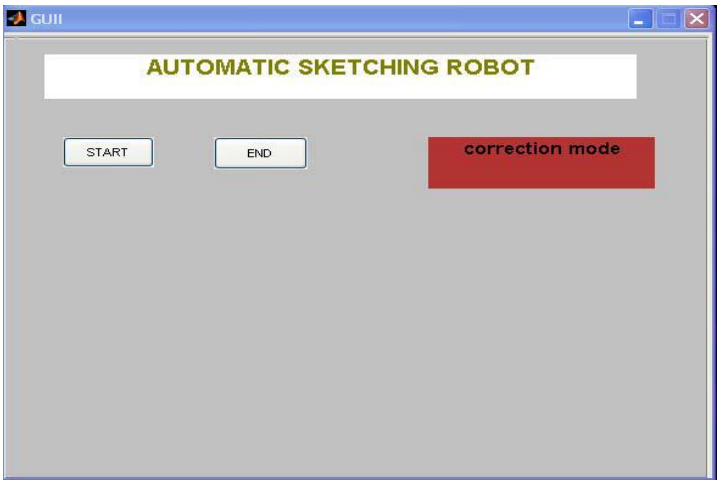


Fig.6: Screenshot of GUI.

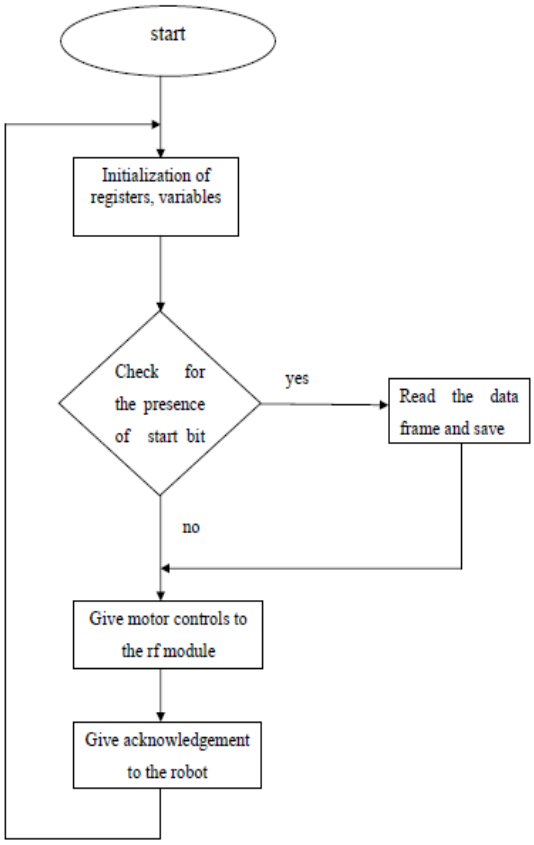


Fig 7 :Flow Chart for Pic1 Program

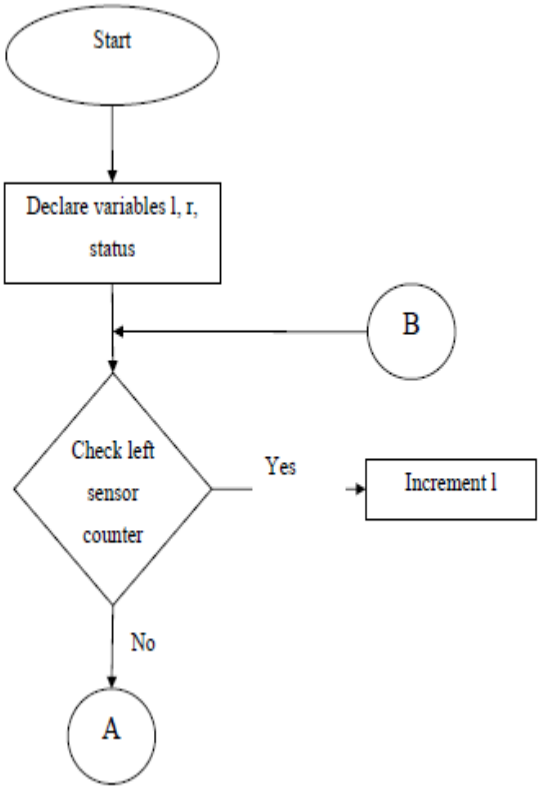
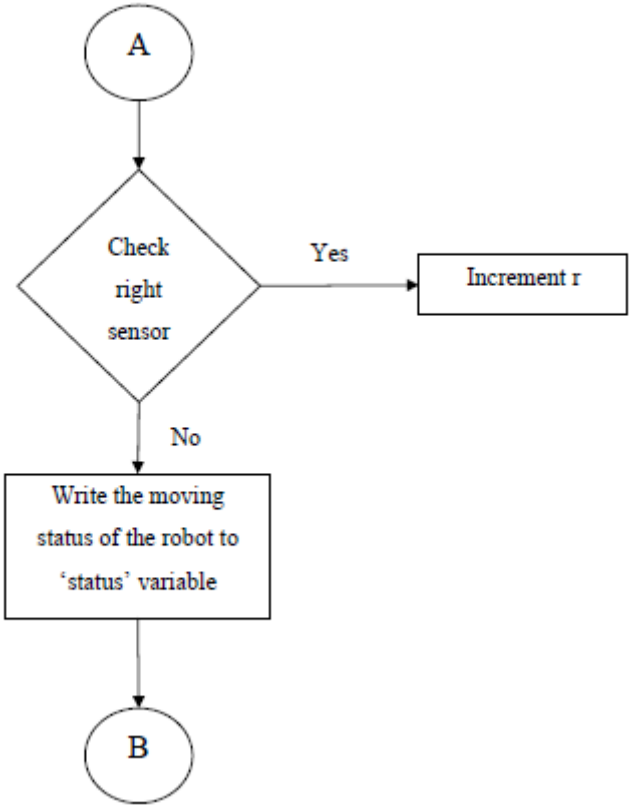


Fig 8: Flow Chart for Pic2 Program



Here 'status' variable represent whether the robot moving straightway or turning. If turning we need to transmit the difference in the traveled distance of wheel. Following is the interrupt service routine off pic. The pic automatically execute the below code when the lower nibble of PORTB changes. For that we need to set the global interrupt enable bit and portb pin change enable bit. The interrupt service routine follows

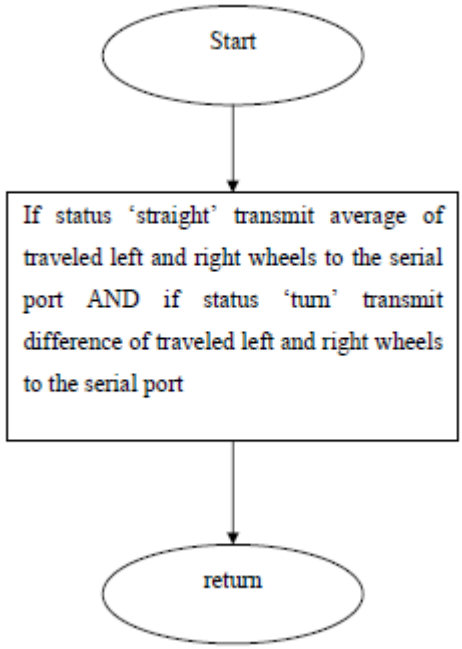


Fig 9: Portb Pin Change Interrupt Service Routine 1

IV. RESULTS AND SIMULATIONS

The below is the experimental results of distance sensor. The CRO waveform from the collector of transistor amplifier ,when a IR wave is sensed is given below. The voltage division is 5v.

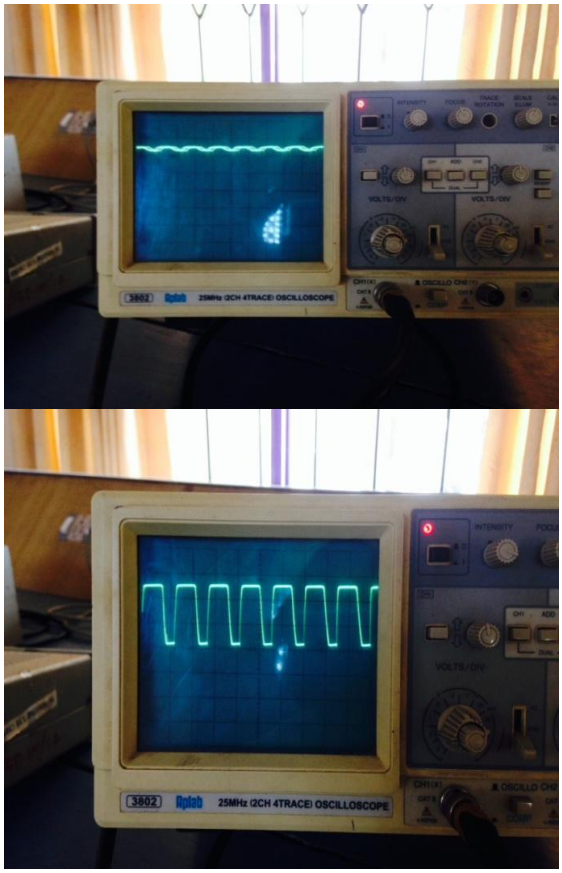


Fig 10: Distance Sensor Result (a) At Rest State.(b) when a IR Ray is Sensed.

Advantages

Using this system we can do the survey very easily and fast. we have only need to run robot along the boundaries. it can be done by any person without any experience. And also no need of fixing of rods and other extra things. In auto station like equipments we need to align the laser beam, which is a time consuming task .It can measure any complex shape' area. And system cost is very less .Another important factor is the maintenance. The system must made of long life and less wear , tear components. Since it is does not use very complex mechanical moving parts and transistors and ic 'are very long life one we can say it is maintenance free. .In this project we use real time transfer of measured values. We can use any storage devices like USB, memory card. The measured values can store to the memory and retrieve at the last. Using this method we can reduce the cost and noise of RF module

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