SMART WI-FI ROBOT CAR WITH CAMERA

CONCEIVED AS A CONDITION OF COMPLETING STRATA STUDIES PROGRAM AT THE DEPARTMENT OF ELECTRICAL ENGINEERING, FACULTY OF ENGINEERING

MADE BY :

SHAKER ABU SHUKOR

D 400 144 005

ELECTRICAL ENGINEERING, STUDY PROGRAM OF ENGINEERING

UNIVERSITAS MUHAMMADIYAH SURAKARTA

2017

Approval Page

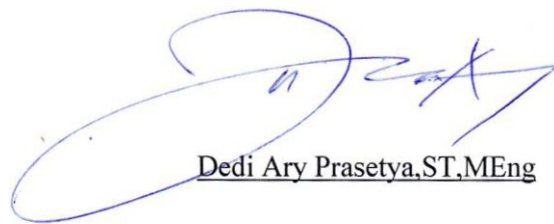SMART ROBOT CAR WITH CAMERA

SCIENTIFIC PUBLICATION

BY

SHAKERF.K.ABUSHUKOR

D 400 14 400 5

Has been inspected and approved to be tested by :

SUPERVISOR

Dedi Ary Prasetya,ST,MEng

Approval Page

SMART ROBOT CAR WITH CAMERA

BY

SHAKER F. K. ABUSHUKOR

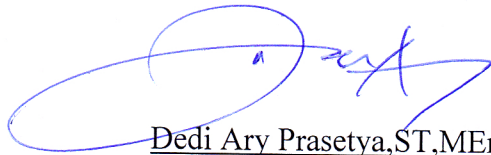IT HAS BEEN MAINTAINED IN FRONT OF THE BOARD OF EXAMINER OF FACULTY OF ENGINEERING UNIVERSITY OF MUHAMMADYAH SURAKARTA

ON THE DAY.......26.........., DATE......july........ 2017
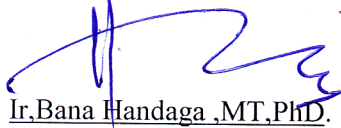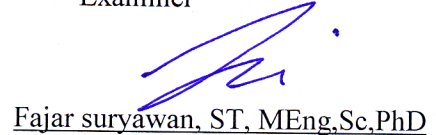
AND DECLARED QUALIFIED
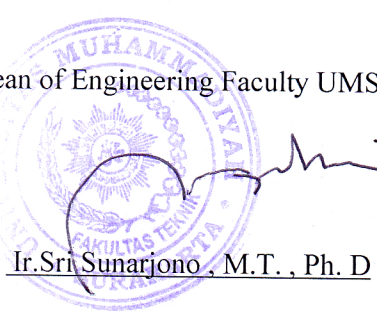
BOARED OF EXAMINERS

Supervisor

Dedi Ary Prasetya,ST,MEng

Examiner

Ir,Bana Handaga ,MT,PhD.

Examiner
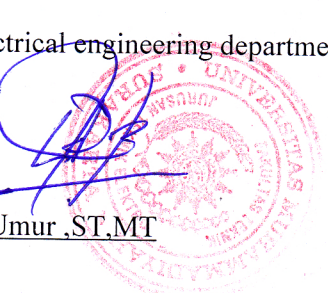
Fajar suryawan, ST, MEng,Sc,PhD

Dean of Engineering Faculty UMS

Ir.Sri Sunarjono , M.T. , Ph. D

Head of electrical engineering department

Umur ,ST,MT

ii
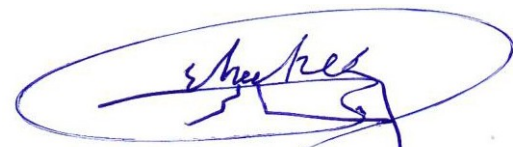
STATEMENT

I hereby certify that this thesis there are works that have been asked to obtain a degree Baccalaureate in a college, and my knowledge also does not have works or opinions ever written or published another person, except in writing referred to in the text and are mentioned in bibliography.

lf it is found there is untruth in my statement above. it will be my accountability to the fullest.

SURAKARTA ,.7-M ⲧ:J……. 2017

Writer

SHAKER F. K. ABUSHUKOR

D400144005

iii

Smart Wi-Fi Robot car with Camera

Shaker F. K. AbuShukor

Email: shaker.abushukor@gmail.com

Abstract

In this paper , We will discuss how to control the car Robot using the Wi-Fi module through a Smartphone.

This robot is used in a variety of areas and uses for various purposes, which is controlled remotely about ±100 meters away. This is useful for espionage and natural disasters and helps keep the controlling person away from danger or out of sight in case of espionage.The robot has several DC motor to move from one place to another and several sensors collect the data and send it to the microcontroller (Arduino). There is a base-mounted camera with two servo motors to control the direction of the camera with 180 degree rotational motion and 90 degrees vertical.The camera and ultrasonic sensors are used to provide the necessary data from the surrounding environment of the robot to Robot in automatic condition, manual condition control by press button on application . The car along together with camera can wirelessly transfer video in real time .. The car is able to reach a particular destination smoothly and intelligently.

Keyword- Wi-Fi Robot, Arduino system, smart Robot, Education.

Abstrak

Dalam tulisan ini, Kami akan membahas bagaimana cara mengendalikan mobil Robot dengan menggunakan modul Wi-Fi melalui Smartphone. Robot ini digunakan di berbagai area dan kegunaan untuk berbagai keperluan, yang dikendalikan jarak jauh sekitar ± 100 meter. Ini berguna untuk spionase dan bencana alam dan membantu menjaga orang yang mengendalikan jauh dari bahaya atau tidak terlihat dalam kasus spionase. Robot memiliki beberapa motor DC untuk berpindah dari satu tempat ke tempat lain dan beberapa sensor mengumpulkan data dan mengirimkannya ke Mikrokontroler (Arduino). Ada kamera base-mounted dengan dua motor servo untuk mengendalikan arah kamera dengan gerakan rotasi 180 derajat dan 90 derajat vertikal. Kamera dan sensor ultrasonik digunakan untuk memberikan data yang diperlukan dari lingkungan sekitar robot ke Robot di Kondisi otomatis, kontrol kondisi manual dengan menekan tombol pada aplikasi. Mobil bersama dengan kamera bisa secara nirkabel mentransfer video secara real time .. Mobil ini mampu mencapai tujuan tertentu dengan lancar dan cerdas.

Keyword- Wi-Fi Robot, Arduino system, smart Robot, Education.

1. INTRODUCTION

A robot is a machine designed to execute one or more tasks repeatedly, with speed and precision. There are as many different types of robots as there are tasks for them to perform. A robot is a mechanical or virtual artificial agent, usually an electro-mechanical machine that is guided by a computer program or electronic circuitry. Robots can be autonomous or semi-autonomous. Robots have replaced human in performing repetitive and dangerous tasks which humans prefer not to do, or are unable to do because of size limitations, or which take place in extreme environments such as outer space or the bottom of the sea.[3]

The advent of new high-speed technology and the growing computer Capacity provided realistic opportunity for new robot controls and realization of new methods of control state. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices[1], In recent years, the applications of mobile robot have gradually become more diverse, which makes the robot closer to people's daily life. At present, the middle and small scale motion robot are usually designed based on single chip microcomputer without operating system.[2] This is why we are doing a study of the surrounding environment with simple research to see the world's need for robots and their importance and needs in daily and practical life, therefore we need robots with the advent of the age to reduce the risks against human life.

So we have done this project which is a robot with remote control by Wi-Fi network with automatic control or manual control.

This project is described as a new solution for Robot control systems. In general; the robots are controlled through wireless network.

Wi-Fi technology expanded to next level because Wi-Fi connection not only use to surf internet but Wi-Fi connection can be used to control home appliances such as television, stereo, room lighting, alarm and many more appliances wirelessly [4]

Hence it is possible to control a robot using a Wi-Fi connection.

When the client sent the control signal, it is transmitted wirelessly and is captured by the Wi-Fi module on the robot. This signal is transmitted to microcontroller.

Microcontrollers analyze this signal and it takes appropriate action to rotate the motor, either clockwise or anticlockwise. Due to this we can control the movement of robot either in forward or backward left or right directions.

A Camera on the Robot captures the video and transmits it to the client, which gives the current position of the robot. Based on that video we can determine whether we need to move the robot forward or backward.

Keys pattern are designed on an application through it the robot will be controlled.

Proposed System

The car is able to move from one place to another easily. The car can be used for relief and safety purposes. The robot car is also able to perform various tasks such as moving an object from one place to another without human help.

2-SYSTEM OVERVIEW

The Figure 1 shows the research flowchart. This project started preparing equipment, hardware and software to be used, so we purchased equipment, hardware and installed the software program such as DC motor , servo motor ,camera and sensors . After that, build the Robot and connect the Dc motor , make test , if there's any trouble should repaired the Robot and so on . connect sensors , camera , servo motor and upload software , make another test , If the test fails, the robot needs to fix the bugs, so from feedback can fix the mistakes then retake the test. If the test result is appropriate and correct we can continue the project, then the results and changes are collected, collected and analyzed and then started writing the journal.
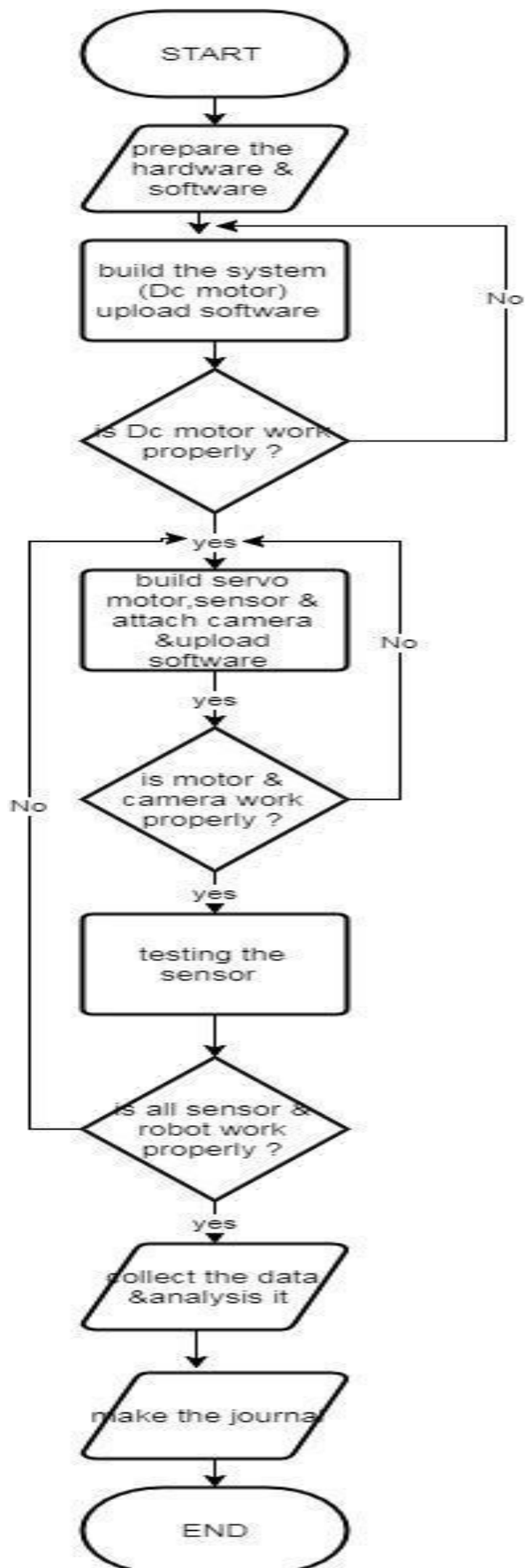
Fig.1 Flowchart of Research

As shown in figure 2 Microcontroller (Arduino) is the heart of our project along with Wi-Fi module . The batteries(power) are used to supply the microcontroller with the power needed that it's also needed to do operation, also to run other components .

As Arduino receives the signal from Wi-Fi Module, it translate the signals using the code which is installed and upload in the Arduino , Arduino send commands to the components to be executed. different Signals such as Forward, Back, Left and Right movement of the Robot car, servo motor of camera, ultrasonic sensor and the signal for video transmission.
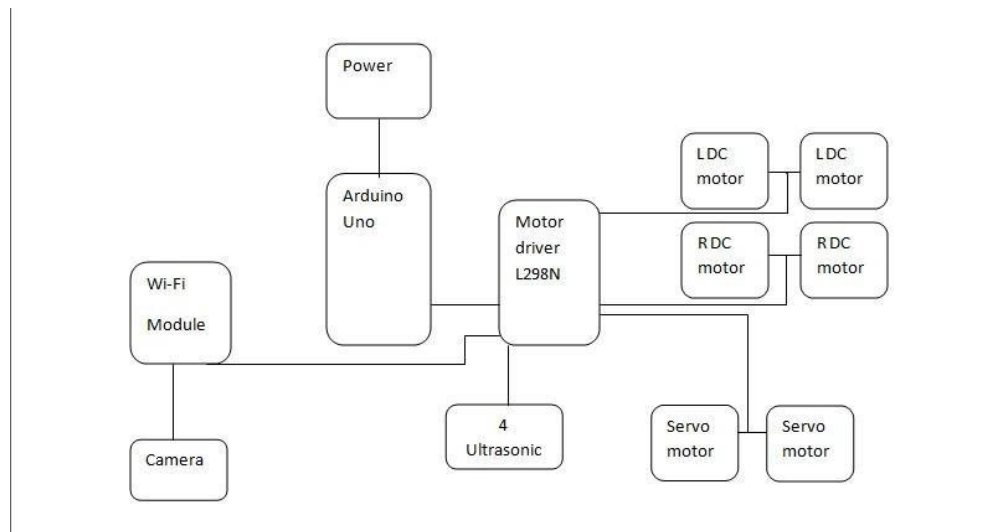

Fig.2 Block diagram of Wi-Fi Robot

MATERIALS REQUIRED

1) Microcontroller (Arduino uno).
2) Wireless Receiver (Wi-Fi Module).
3) Web camera 720p HD night vision camera.
4) Motor shield drive module for Arduino (L298N).
5) 1800mah 8A 7.4V 18650 Lithium battery.
6) Chassis &rubber wheel.
7) Ultrasonic sensor.
8) Electric motors DC gear motor.
9) Servo motor.
10) 4 wheels.

3-HARDWARE DESIGN

Figure (3-5) show chassis of robot used to shape the basic of the robot , it is made from aluminum alloy with weight 1500 g and lengthwise dimensions of 28 cm and 17 cm width.. The chassis is convenient for robot as we already have microcontroller ,Wi-Fi Module and camera, sensors on the platform.
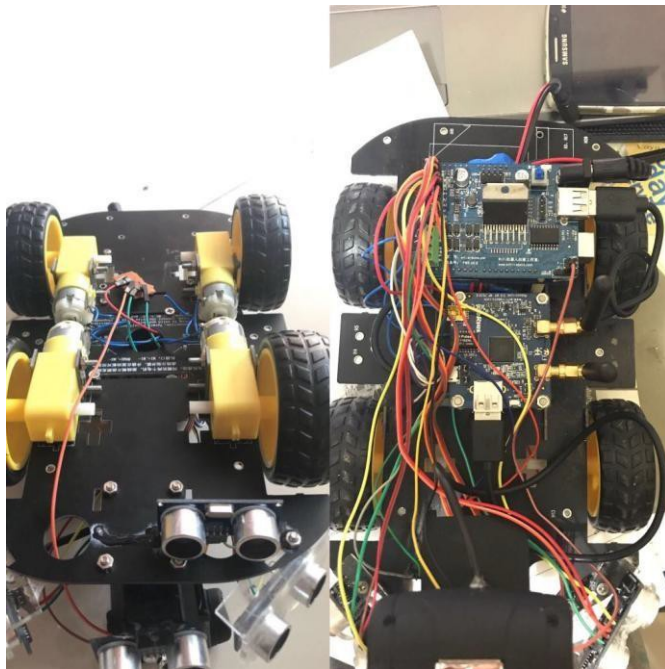

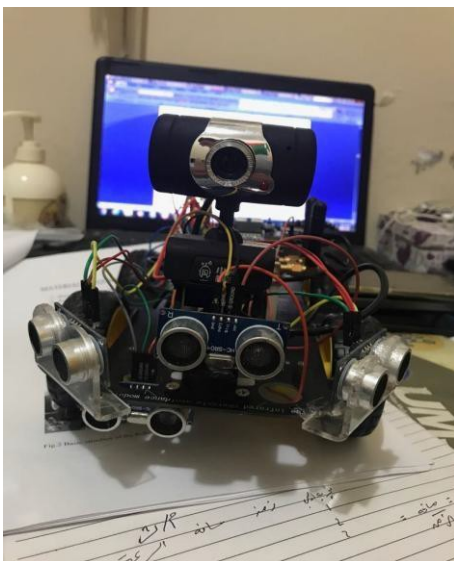Fig.3 Basic structure of the Robot , Top&Bottom view
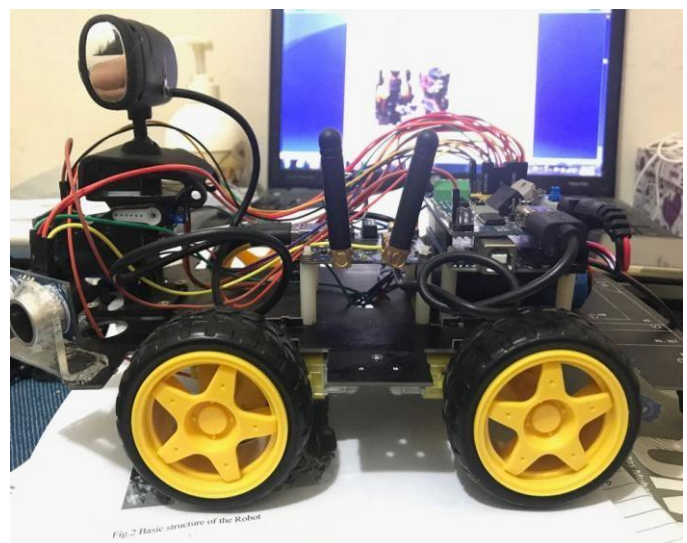

Fig.4 Front view of Robot

Fig.5 Side view of Robot

In our design we have chassis , above chassis there's microcontroller and other , under chassis there's four DC motors and sensor.

Microcontroller, driver motor , Wi-Fi Module and battery are placed on chassis. The camera is attached at the front end on the upper of the chassis with ultrasonic sensors also.

The following components were used in this project which is explained and show in figure (6-11) as follows:-

3.1 Microcontroller (Arduino Uno)

Arduino is an electronic board based on Atmega328 IC, Arduino UNO consist 32 pins (input/output), 6 of these can be used analog input ,14 used PWM output .

it can easily connect with computerand upload the code by USB cable , Operating on a 5 volt voltage source.

Arduino can communicate with the surrounding environment by connecting to sensor devices, or by connecting it to motors, small LED and other electronic devices.

3.2 Motor shield drive (L298N)

L298N is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L298N is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L298N.

3.3 DC Motor

12 V DC motor It can be used in many areas, especially in robots, with relatively lightweight and high torque, allowing it to climb the slopes and some hills.

3.4 Servo motor

The servo motor have gears Which allows to control them accurately. because of that can allow the base to be placed at different angles ,usually between 0 and 180 degrees.

3.5 Ultrasonic Sensor HC-sr04

This sensor is attached to detect the distance of the obstacle from the robot. It uses sonar to govern distance of an object. It inaugurate non-contact range detection, and provide stable reading in an easy to use package. Its range varies from 2 cm to 400 cm or 1'' to 13 feet. Sensor is not affected by sunlight or black material but it is difficult to detect the distance from any soft material like cloth.

 It is a combination of both ultrasonic transmitter and receiver module. Its output is greatly perturbed by Echo signal, so the output never goes Low if Echo is not received. Even timeout parameters are needed to alter the output according to the user aspirations. Its resolution is 0.3 cm and trigger input pulse width is 10μS.

3.6 Android

Android is a mobile operating system developed by Google based on Linus Kernel and is mostly wield with touch screen smart phones .Android platform is reliable for building an android application, android is a common choice of people while they buy any cell phone. Android provides easy accessibility and understandability of different aspects for daily use. They are widely known as mobile computers and are expanding the sale of smartphones worldwide. They are widely accepted as they provide open architecture, platform independent and enormous capabilities. It is built from JAVA programming language and as android uses JAVA, android API provide easy access for hardware components. Android may use USB, Wi-Fi and Bluetooth for connecting with the robot.

3.7 WIFI MODULE

WI-FI is a popular electronic device that sends radio waves over the network to allow the exchange of information and data wirelessly .Covers an area ranging from 50 meters outdoors and less inside the walls.

Features :

a) through the WIFI transmission of video
b) forwarding instructions from the network to serial output
c) dual antenna 300Mbps wireless throughput. Drive the camera default 640x480 30fps !
d) each module has been calibreed to ensure performance!

Module function

a) The acquisition of USB camera image , sent to the client through the mjpeg format display
b) The network - serial port forwarding

Application scenario

a) Wi-Fi video car robot.
b) Smart home.
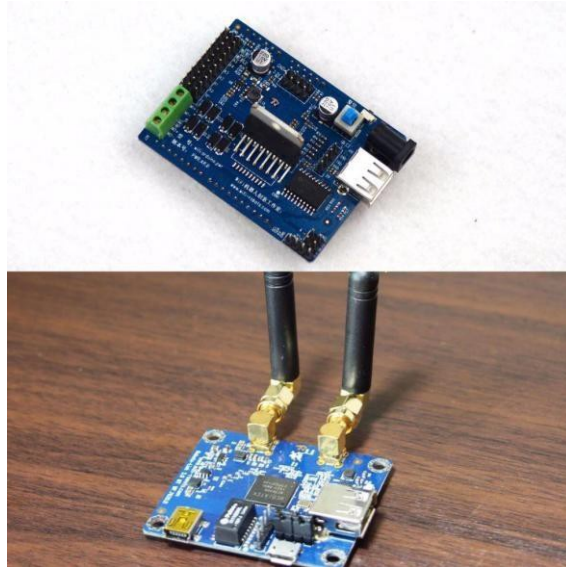
Fig.6 Wi-Fi Module and Motor driver.

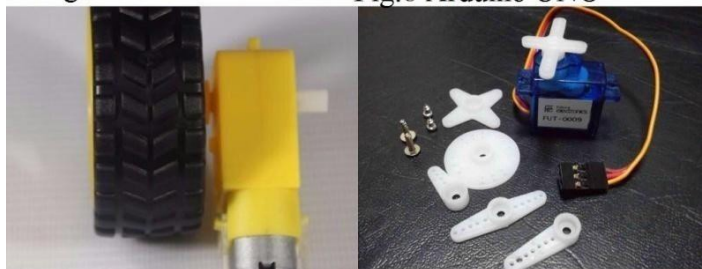Fig.7 Ultrasonic sensor   Fig.8 Arduino UNO

Fig.9 DC motor with wheel   Fig.10 servo motor

3.8 Camera

The Robot-Eyes USB Video Camera is used in robotic car, shown in figure 11.

The camera plugs into your system via a USB connector.

An excellent camera for when you are using FPV to drive your car around or just for videoing where you go.

Specs:

FOV: 100 degrees

Focal Length: 100mm to infinity

Hardware Pixels: 300K

Resolution: 640x480

Focus: Manual

Fig.11 USB Camera

4-SOFTWARE

Arduino

Arduino is platform IDE that works with the Arduino control for writing ,compile and upload code to board .The program provides support for a wide range of Arduino boards such as Arduino UNO ,mega pro mini .The pouplic and similar languages for Arduino are C++ and C .

So the program appropriate for programmer that know about these languages .

in figure 12 show a flowchart of Arduino system and steps of car Robot .also it show the multi condition for Robot such as automatic control or manual control ,as well provides an overview of how the project works to the reader.

moreover the programming divided to multi functions to make the program easy to understand and analyze the data , also to be more faster when call that programming parts..
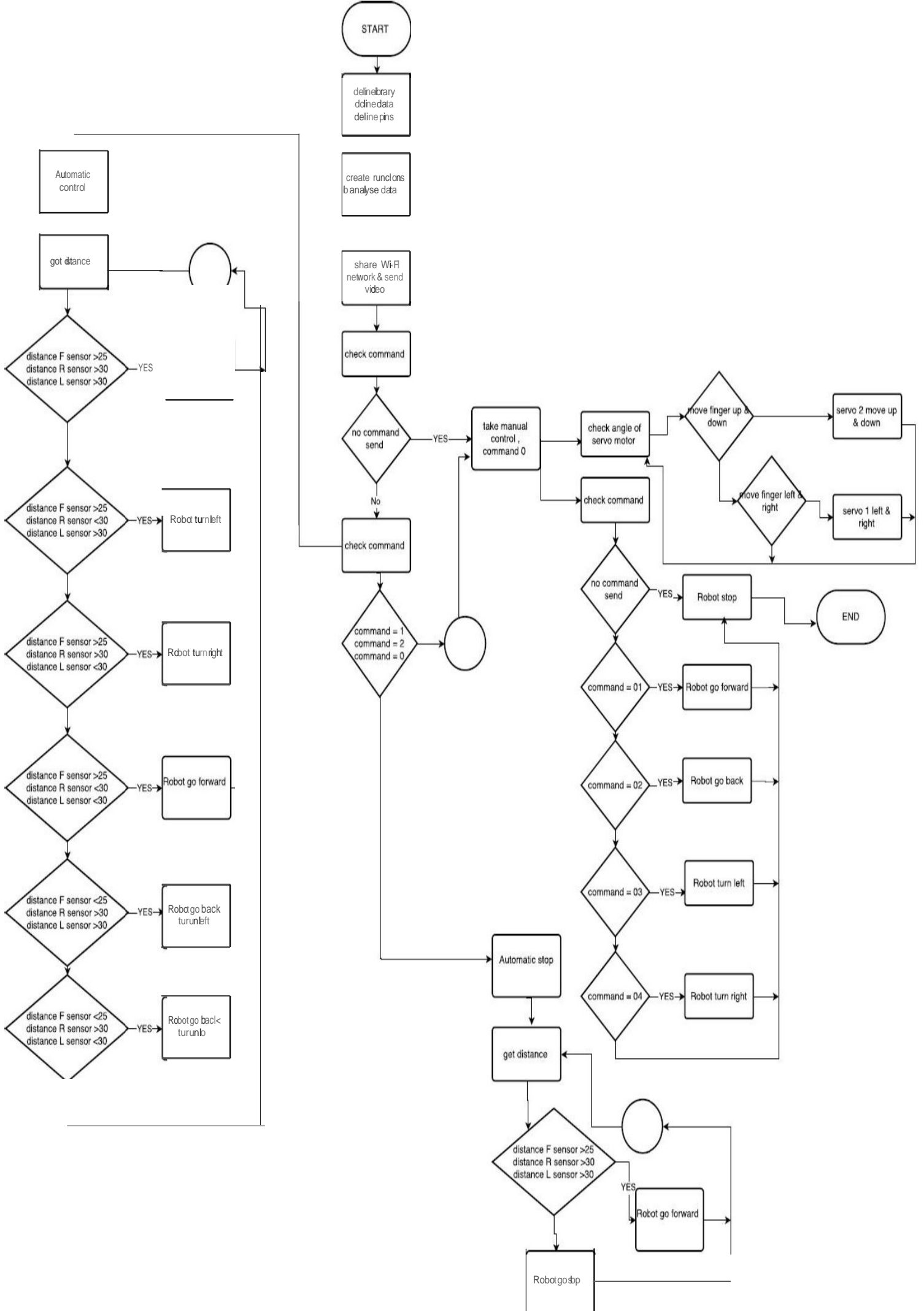
Fig.12 Flowchart of Arduino System

5-THE RESULT AND ANALYSIS

Wi-Fi robot car is a robot Remote control using the phone (Android) with a vector for the picture and video to the phone.

Wi-Fi robot Multi-tasking and functionality (multi-mode(,The robot has two main conditions that can be activated,

They are as follows :

- ✓ **Manual Control**
- ✓ **Automatic control**

Manual Contro

In this case the robot car controlled by phone,turn on the robot,The robot is running and share hotspot , make connection with that hotspot,Then open the application and press Start, and choose Normal Control.

In this case there are four buttons as shown as in figure 13, forward, right, left and back .

When the buttons are pressed, the signal is transferred to the robot and then to the controller. The signal is analyzed , the transmitted step is taken if it is forward, backward, right or left the robot start move.

In the table 1 show the condition of motor and its motion when the robot move .

Fig.13 screenshot of Android App.

The Servo motor, which controls the base of the camera ,It is controlled by the phone by passing the finger on the screen with a horizontal movement of 180 degrees or vertical movement of 90 degrees.

Fig.14 side view of the system

The video is taken from the camera and sent to the controller and Wi-Fi model , then to the phone like figure 14 show.

Automatic control

In this case robot Controls with ultrasonic sensors installed at the front of the robot.

There is two state in this case :

First state : Turn on it by choosing it from phone , The robot start moving forward If there is any obstacle or object in front of it 25 cm away, the sensors send it to the controller and orders are sent to the DC motor to stop immediately. The robot remains in a state of stillness until it is changed to another condition.

Second state : Turn on it by choosing it from phone , The robot start moving forward If any obstacle or object is found in front of the robot it is back and looking through another without obstacles, if the obstacle or the object on the left side, the robot will change its direction by turning to the right, if the obstacle or the object on the right side, the robot will change its direction by turning to the left , if the obstacle or the object on the left and right side, the robot will keep moving forward, The robot stays on this case until it is changed to another condition and turn it back to manual controlling .

Table 2 show the motion of Robot when automat condition on and the distance between the objects with Robot ,the sensors will send the signal to controller , controller send commands to Robot ,Robot move automatically.

Condition of motor	D1 LEFT	D2 LEFT	D3 RIGHT	D4 RIGHT
Left & Right Motor-Stop	0	0	0	0
Forward	Anticlockwise ∪	Anticlockwise	Anticlockwise	Anticlockwise
Back	Clockwise ∩	Clockwise	Clockwise	Clockwise
Left	Anticlockwise	Anticlockwise	Clockwise	Clockwise
Right	Clockwise	Clockwise	Anticlockwise	Anticlockwise

Table 1: show motion of Wi-Fi Car Robot

Place of objects & distance /cm	Condition of motor
Left <30	Turn right
Right <30	Turn left
Front of robot <15	Go back, turn left or right
Left &Right <30	Forward
Left ,Right&Front <20	Back

Table 2 : show motion when automat condition on

Experiment number	Time	Distance	Speed
I	17.06	10	0.58 m/s
II	16.66	10	0.6 m/s
III	17.02	10	0.587 m/s
IV	16.76	10	0.59 m/s
V	16.82	10	0.59 m/s

Table 3: Table speed of car

As shown in table 3 the car test many time in same distance to calculate speed by :

$$\text{speed}=\frac{distance}{time}$$

To calculate speed average $time$

$$average=\frac{0.58 + 0.6 + 0.587 + 0.59 + 0.59}{5} = 0.5894 \ m/s$$

The reason for multiple values in experiments is due to several reasons :

    a) The ground is not straight.
    b) The floor is a little bumpy.
    c) Human errors.

If the car was to be driven to very far away, more than it's rang, the camera wouldn't be able to send back data.

The car is able to wrap around itself at a 360 degree angle.The car avoids obstacles and objects in the case of automatic control .

If the car meets a small object vertically (base of chair), it's can't recognize it.

The robot can be connecting with Smartphone with distance 90-100 M with good controlling .
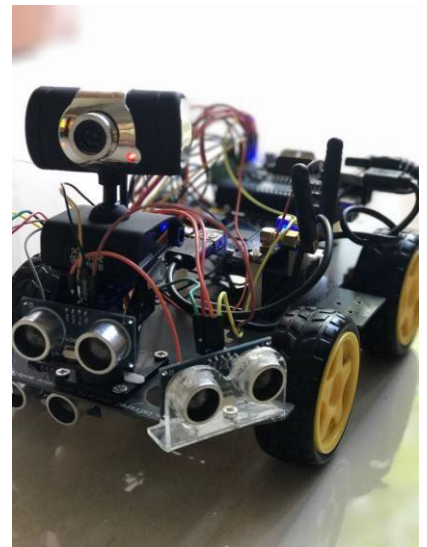

Fig.15 Image of Result

7-CONCLUSION

This project is implemented so that the robot can be controlled by the smart phone, the phone and the robot are connected to the cordless wireless network, so that the phone can connect with the robot up to a distance of 100 m.

This robot can navigate freely with the possibility to rotate and rotate at 360 degrees at the same point.

The robot has sensors on the front to avoid obstacles and objects.

The robot has a camera mounted on base ,can move horizontally 180 and 90 degrees vertically.The camera transfers photos and videos directly to your smartphone and displays them on your phone.

Reference

[1] M.Selvam1 ,1M.E. Embedded Systems, Dept. of ECE, Karpagam University, Coimbatore, Tamilnadu, India-641021, SMART PHONE BASED ROBOTIC CONTROL FOR SURVEILLANCE APPLICATIONS .

 [2]Volker Graefe und Rainer Bischoff.From Ancient Machines to Intelligent Robots -A Technical Evolution[C].The Ninth International Conference on Electronic Measurement & Instruments. 2009. Vol.3, 418-431.

[3] Madkar (Assistant Professor), Vipul Mehta, Nitin Bhuwania, Maitri Parida , Electronics Department, BVDU College of Engineer, Robot Controlled Car Using Wi-Fi Module.

[4]Raymond J. Smith (2003). "Wi- Fi Home Networking". New York, NY. McGraw-Hill.

[5] Mohammed Saquib Khan , Ataur Rehman Khan , Altamash Khan , Akmal Kalia , Lochan Bisne, WI- FI Based Robot Controlling by Webpage Interface and Video Monitoring.

- Pavan.C, Dr. B. Sivakumar, Wi-Fi Robot For Video Monitoring & Surveillance System .

International Journal of Scientific & Engineering Research Volume 3, Issue 8, August.

- Mohammed Hisham, Sudhir V Prabhu, Ashwin Kumar, Manipal, A Wi-Fi Enabled Robot

Centre for Information Sciences, Manipal University, Manipal, India.

-Networking and Internet Applications' by Sangay Yeshi.

- www.wifibot.com.

- https://www.arduino.cc