A Novel Approach to Autonomous Farming Robot

Ronak Mistry
Assistant Professor of ECE Dept,
SRI Vadasma,
Mehsana - Gujarat, India

Kishan Malaviya
Embedded Developer,
R&D Dept,
CK-IICT PVT LTD
Ahmedabad-Gujarat, India

Harsh Kotak
Student,
ECE Dept,
SRI Vadasma,
Mehsana - Gujarat, India

Harshil Bhatt
Student,
ECE Dept,
SRI Vadasma,
Mehsana - Gujarat, India

Urvi Patel
Student,
ECE Dept,
SRI Vadasma,
Mehsana - Gujarat, India

Abstract — Now-a-days everyone has lost interest from farming as it has become a very difficult and tedious job. Although hi-tech vehicles and equipment have overcome older version of vehicles and equipment and also they made farming quite easy. But it still requires a plenty of human effort. Today automation has been introduced in almost every form of industry and a prominent reason to reducing human effort. Our Objective is to reduce human efforts in farming as we planned to develop an autonomous guidance system for farm vehicles. Our system will be based on Global Positioning System (GPS) [1]. To develop complete autonomous system, other than GPS, systems like machine vision, laser-based sensors, inertial sensors would be needed to be employed for avoiding obstacles in the path and overcoming other challenges. However making such systems would require more time and monetary resources then available, hence developing such complete autonomous system is out of scope of the current task at hand. Our aim is to develop a Mixture of such complete autonomous system which will fulfill one of the Basic needs of a complete autonomous guidance system.

***Keywords** – Agriculture, Robot, Autonomous, GPS, Farming*

*****

I. INTRODUCTION

Automated guidance system in the farming field can greatly reduce the farmer's physical effort and as a result this system brings increment in productivity and safety of farm operations. After studying Different approaches in farming field and proposed for realizing automatic guidance for agricultural vehicle, based on global positioning system. These are machine vision with GPS receiver; guidance of tractor based on Location (Longitude and Latitude) and lased based system to avoid hurdles in the field. Real time Location based GPS systems can provide sub-inch accuracy. These will provide accuracy up to a centimeter or less. Corrective signals can be send from the base station and it can be helpful in several moving stations to arrive at desired position. With the help of accurate differential carrier phase measurements of satellite signals, CDGPS-based systems have demonstrated centimeter-level accuracy in vehicle position determination. Today, global positioning system (GPS) is one of the most common types of navigation sensor. It is easily available and also applicable everywhere. Hence, we used the common GPS device with magnetometer, accelerometer and Ultrasonic sensor to automate the farming vehicle.

Operating Autonomous agricultural equipment accurately can be difficult, tedious, even hazardous work. Automatic control offers many advantages over human control; however, previous automatic agricultural vehicles have been unsuccessful due to sensor limitations. [2] With the recent development of new technology like Carrier Phase Differential GPS, a single inexpensive GPS receiver can measure a position of vehicle within a few centimetres. This ability to provide accurate real-time information about multiple vehicle states makes CDGPS ideal for automatic control of vehicles [2]. After various tests, a model was demonstrated to a one-s accuracy of better than 1˚-4˚, and a model which can track a standard deviation of Accurate than 2.5 cm [2].

II. RELATED WORK

Agriculture has always been accorded an important position in the India’s Development. Agriculture in India much more incomparable with other countries. [11] But due to lack of interest and modernization, our traditional agriculture system has decayed. Due to this the economy of our country has got declined with increase in poverty and malnutrition. Thus Indian agriculture requires Betterment in farming and maintaining the field so that people’s interest towards Farming Develop. In our proposed system it is made possible with the help of sensors such as Ultra sonic sensor which checks the obstacle in field.[1] With the help of modern vehicles and equipment Precision farming clinches swift time responses to dreadful environmental and weather forecasting issues with efficient controlling capacity for production and reduced labor machination. This arrangement of highly self-directing agricultural system requires vigorous sensing at the field and fleeting communication in the air for the information transmission is necessary. The propose system of project are combination of many functions. Modern technique like GPS is used to guide field location, Ultrasonic sensor to avoid obstacles, soil moisture to sense, accelerometer and magnetometer is use to right direction of farming vehicle and fill the requirement of water and auto-steer systems to make vehicle follow that GPS guidance without human hands[10].

THESIS REVIEW

Simon Blackmore, Bill Stout, Maohua Wang, Boris Runov Developed agriculture needs to find new ways to improve efficiency. One approach is to utilize available information technologies in the form of more intelligent machines to reduce and target energy inputs in more effective ways than in the past. Precision Farming has shown benefits of this approach. The advent of autonomous system architectures gives us the opportunity to develop a complete new range of agricultural

ISSN: 2321-8169
2362 – 2366

equipment based on small smart machines that can do the right thing, in the right place, at the right time in the right way [13].

Gholap Dipak Dattatraya , More Vaibhav Mhatardev , Lokhande Manojkumar Shrihari , Prof. Joshi S.G system with high speed of operation for an advanced agriculture process which includes cultivation based on robotic platform. The robotic system is an electromechanical (conveys a sense that it has agency of its own) and artificial agent which is steered by DC motor which has four wheels. The farm is cultivated by the machine, depending on the crop considering particular rows & specific columns. The infrared sensor detects the obstacles in the path and it also senses turning position of vehicle at end of land. The seed block can be detected and solved using water pressure. The machine can be controlled remotely and solar panel is used to charge DC battery. Assembly language is used in programming the microcontrollers. The microcontroller is used to control and monitor the process of system motion of vehicle with the help of DC motor.[12]

Neelam Rup Prakash, Dilip Kumar, Kesri Nandan, Automatic steering devices for farming vehicles like tractors, seeding vehicle, weed control vehicle, spraying machine vehicle etc. have the task to relieve the driver from the physical and mental stress of monotonous steering work. Simultaneously, they are intended to help him to exploit machines and farming vehicle closer to their full performance and improve the quality of work. Vehicles frequently have to be steered in and exact straight line and along rows in the farm land.GPS receiver fetches the information of positions (latitude and longitude) of the farm land which needs to be cultivated. With the help of GPS and microcontroller. We calculate the boundary of farm land, slope of straight line and angle of movement with the help of slope changes. [1]

III. PROPOSED SYSTEM

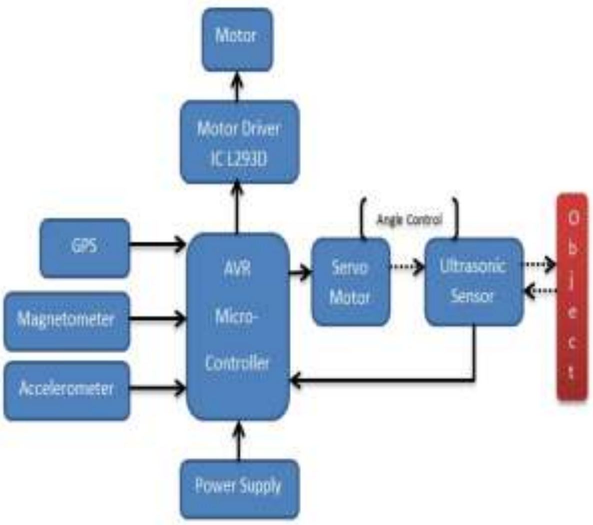

Figure 1. Block diagram

Global Positioning System (GPS) data from satellites lies at the heart of Accurate Agriculture. GPS determine the field of farm. Whole purposed system worked on GPS.GPS track the current location of robot and measure the distance between starting location and current location. After completion of proper length of track it turns opposite side and whole process of tracking is repeated. AVR micro controller is heart of whole purposed system. Obstacle avoidance is important function of system which is done by ultrasonic sensor. Ultrasonic sensor is detecting the obstacle and avoid by performing inbuilt functionality. When obstacle detected by ultrasonic sensor, robot move on right or left side. Movement of ultrasonic sensor is controlled by servo motor .when obstacle present then servo motor turn on left side and check the presence of obstacle. If obstacle is detect then turn on right side else goes on left side. Accelerometer is detecting the direction of robot. Magnetometer is used to detect hiring angle between actual path and virtual path. Vehicle control also takes place in real-time, seeing that the vehicle follows the planned paths. Like route planning, control runs on the on board embedded computer, synchronizing throttle, brakes, and steering to achieve the desired path [4]. This system works on following steps:

1. Acquire GPS signal
2. Fetch Data given by User i.e. Length and Width of Farm, Starting and Ending Location of Robot.
3. Robot moves on field autonomously
4. If any obstacle in its way, then automatically avoid obstacle
5. Return back on Track and continue till it reaches the end location.

Step 1: Acquire GPS signal

12V power supply is given to ROBOT. This will ON GPS, Development board, Servo motor and L293D.

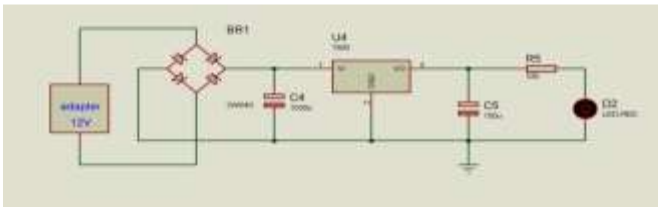

Figure 2. Power Supply Circuit

This is a power supply circuit use in our robot. It gives 12V power. This is enough for all parts of robot.

Step 2: Fetch Data given by User i.e. Length and Width of Farm, Starting and Ending Location of Robot.

After getting proper power from power supply circuit, GPS start getting NMEA (National Marine Electronics Association) Strings. Once proper strings are available, it'll send the entire signal to microcontroller to do rest process. Microcontroller notes starting location of robot.

Figure 3. Controller Board

This Circuit Board contains the power supply circuit, microcontroller, LCD Interfacing Connector, and Digital as well as Analog I/O pins. The circuit board operates on 5V as well as 12V as per necessity. Using Microcontroller as per our requirements, we can use this circuit board to interface lots of external components (i.e. GPS, GSM, Bluetooth, etc) and sensors (i.e. Ultrasonic sensor and other sensors). With the help of this Circuit board we can connect all the peripherals that are needed for our prototype.

Step 3: Robot moves on field autonomously

After getting signal from GPS Microcontroller does all the process and gives signal to L293D, Servomotor and DC motor which help the robot to move in Field freely.

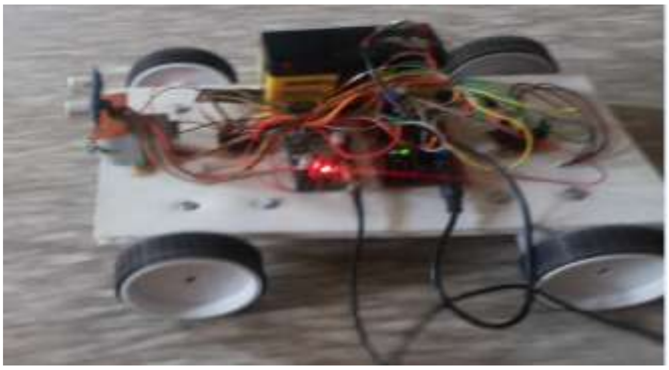

Figure 4. Movement of robot

Step 4: If any obstacle in its way, then automatically avoid obstacle.

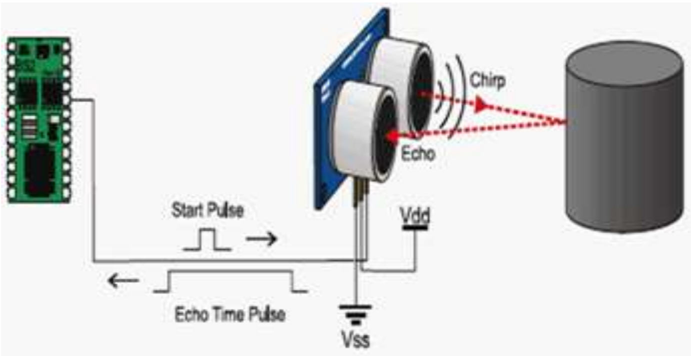

Figure 5. Ultrasonic detcting obstacle[6]

After Robot start moving in field if any obstacle comes it is detected by Ultrasonic sensor. Ultrasonic sensor is connected to servo motor which movement is 0 to 180 degree.[6] This Ultrasonic sensor works as eye of Robot.

As show in figure Ultrasonic sensor send signal and gets echo signal. This way obstacle is measured. If there is obstacle on both the side robot moves back.

Figure 6. Obstacle Detection in field

Step 5: Return back on Track and continue till it reach the End location.

After Detection of obstacle on both the side Robot reverse and take right turn. While moving right micro controller counts how much distance robot have moved right and at same times Ultrasonic sensor keep on sensing wheatear Obstacle is over or not. Once obstacle is over it tries to be back on original path. And continues moving till the given distance is over.

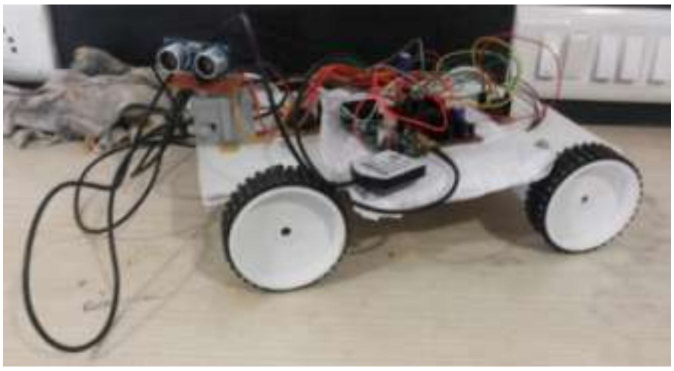

Figure 7. Working prototype

Servo motor is mounted on head of the robot and ultrasonic sensor is attached on servo motor. When servo motor change angle then ultrasonic sensor worked as eye and find obstacle**.** Controller and GPS is place in middle of robot.L293D drive IC used to drive the robot. Here two driver ICs were used, where one for front wheels and another for back wheels.

IV. CIRCUIT SIMULATION AND WORKING OF SYSTEM

Combining all the circuits we are able to get final circuit of this working prototype. This circuit is as shown in Fig.8. Ultrasonic sensor Eco pin is connected to Pin17 of micro controller and its trigger pin is connected to Pin 18 of micro controller. GPS TX Pin is connected to RX of micro controller Pin 23. Servo motor is connected to Pin 15 of Micro controller. Here two L293D IC is use One for LEFT Motor and another for RIGHT. For Left Motor, L293D Pin 2 is for BLP (Back Left Positive) which is connected to Pin 11 of Micro controller. Pin 7 of L293D is for BLN (Back Left Negative) which is connected to Pin 6 Micro controller. Pin 10 of L293D is for FLP (Front Left Positive) which is connected to Pin 5 Micro controller. Pin 15 of L293D is for FLN (Front

ISSN: 2321-8169
2362 – 2366

Left Negative) which is connected to Pin 4 Micro controller. For Right Motor, L293D Pin 2 is for BRP (Back Right Positive) which is connected to Pin 2 of Micro controller. Pin 7 of L293D is for BRN (Back Right Negative) which is connected to Pin 3 Micro controller. Pin 10 of L293D is for FRP (Front Right Positive) which is connected to Pin 12 Micro controller. Pin 15 of L293D is for FRN (Front Right Negative) which is connected to Pin 13 Micro controller. Power supply circuit is made to give power to move Robot.

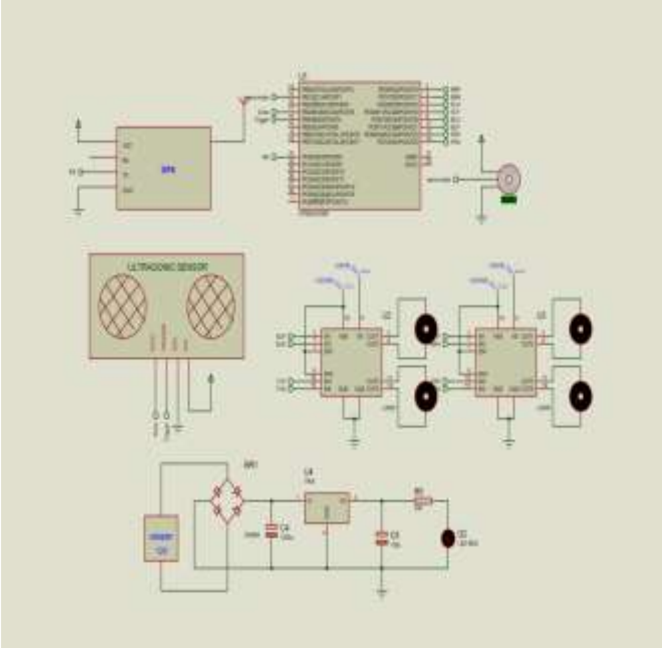

Figure 8. Circuit Diagram

V. Conclusion

This project provides a brief review of the research on guidance system technologies in Farming vehicles. Although the research developments are abundant, there are some shortcomings (e.g., low robustness of versatility and dependability of technologies) that are delaying the improvements required for commercialization of the guidance systems. By applying this project in real time applications it can be conclude that either GPS and machine vision technologies will be 'fused' together or one of them will be 'fused' with another technology (e.g., laser radar) as the trend development for agricultural vehicle guidance systems. The application of new popular robotic technologies for agricultural guidance systems will augment the realization of agricultural vehicle automation in the future.

A. *Simulation Result*

Figure 9. Working on Field

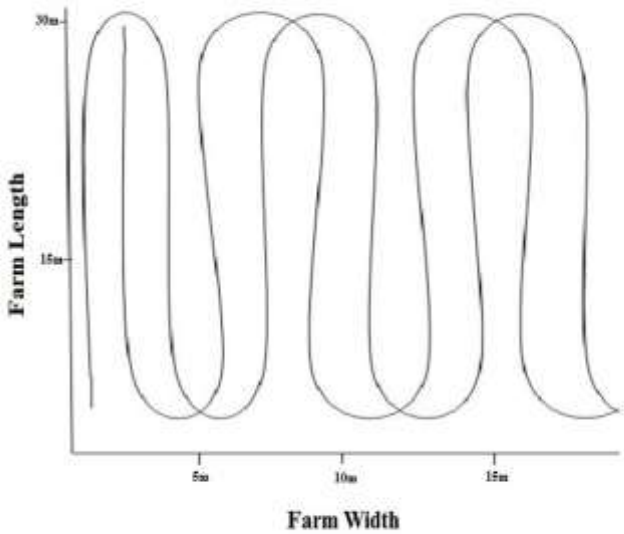

Figure 10. Robot's track

As per figure 10, robot follows zig-zag track. Because user has already given the requires data (Farm's Length and width, Starting and Ending Location) robot will never cross the farm's boundries. Morover it's operation can be manual also.

References

[1] Autonomous Vehicle for Farming Using GPS.www.ijecse.org."Neelam Rup Prakash","Dilip Kumar","Kesri Nandan".

[2] Automatic Steering of Farming Vehicle using GPS. "Michael O' Connor", "Thomas Bell", "Gabriel Elkaim", "Dr. Bradford Parkinson".

[3] Microcontroller By "Muhhamed Ali Mazidi",second edition.

[4] "GPS BASICS", Jean-Marie Zogg, www.u-blox.com

[5] "Wireless Communication", Theodore S. Rappaport, Prentice hall.

[6] "Ultrasonic Sensor", Microsonic Ultrasonic Sensor. www.microsonic.de/en/intresting facts.html

[7] Microcontroller Atmega328.www.atmel.com/devices/atmega328p.aspx.

[8] "Servo Motor", http://www.princeton.edu/~mae412/TEXT/NTRAK 2002/292-302.PDF

[9] "L293D", Ron Robotics. www.rakeshmondal.info/L293D-Motor-Driver.

[10] "Surveillance and Steering of Agricuultural Field using Zigbee". Mr. K. Kirubakaram, Selvi Ramalingam, S. Meerabai, V. Preethi. www.ijritcc.org.

[11] A Simple Method to Improve Autonomous GPS Positioning for Tractors by Jaime Gomez-Gil , Sergio Alonso-Garcia , Francisco Javier Gómez-Gil and Tim Stombaugh.

[12] Robotic Agriculture Machine by Gholap Dipak Dattatraya, More Vaibhav Mhatardev, Lokhande Manojkumar Shrihari, Prof. Joshi S.G. International Journal of Innovative Research in Science, Engineering and Technology.

[13] ROBOTIC AGRICULTURE – THE FUTURE OF AGRICULTURAL MECHANISATION By Simon Blackmore, Bill Stout, Maohua Wang, Boris Runov. 5th European Conference on Precision Agriculture Uppsala, Sweden 9-12th June 2005