Unmanned Ground Vehicle

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Abstract— *Due to new developed technology man is leading a comfortable life. People want each work should be done automatically. So in this paper introduces a system called UNMANNED GROUND VEHICLE. UGV as name indicate it operates in contact with ground and without any human resource. The vehicle will have a set of sensors to observe the environment. In this paper for the working of UGV, FPGA is embedded with image processing. FPGA as main processing platform used to control UGV. The performance evaluation of proposed system takes place by capturing the image of UGV with help of camera. This system demonstrate accurate localization of UGV. This UGV vehicle used in military, mall, automobile industry. To work system properly provide proper interfacing and synchronization between hardware/software module.*

Keywords— FPGA, image processing.

I. INTRODUCTION

UNMANNED GROUND VEHICLE is a vehicle which operates without any human operator and with ground support. The vehicle will have a set of sensors to observe environment and will make decision about its position. There are different techniques of controlling the unmanned ground vehicle. They are

1. Command control mode: In this mode consider the human decision making and providing navigation commands based on the live video signal received from camera mounted on UGV.
2. Gesture control mode: In this mode consider the hand gesture movement, where UGV controlled using commands sent based on the hand movement mapped by the IMU unit.
3. Raptor control mode: In this mode considered the motion tracking system implemented through image processing system.

While going through this techniques we have to suffer from problems such as the system failure in providing high data rates , the processors used in these system have low computational capabilities and low processing speed. To overcome these disadvantages FPGA based system is proposed.

Here major two issues are addressed for intelligent car parking system:

1) Identification of position and orientation of car to localize car automatically.
2) The development of control system capable of controlling in real time UGV which is present in given time.

This paper focuses on 1st issue. A novel field programmable gate array based embedded vision system for indoor localization of UGV whose performance and accuracy are demonstrated to be much better than currently existing system of more complexity.

This paper is arranged in detail as follows. Section I describe the introduction. The literature survey is presented in II. Algorithm, design and implementation, practical implementation, conclusion and future scope is explained in section III, IV, V, VI, VII respectively. Lastly references are mentioned in section VIII.

II. LITRATURE SURVEY

A verity of approaches have been reported in literature for localization of robot:

R. Luo,etal[1] The objective of this paper is to develop multi sensor fusion approach based on particle filter for autonomous mobile robot localization. Ultrasonic sensor and received signal strength (RSS) which are byproduct of Zigbee module used to estimate the pose for mobile robot. Again they used the particle filter to eliminate Transition and rotation error caused by dead-reckoning. It can be used in state-space which is suitable for estimation state or pose of a mobile robot.

A.Gupta,etal[2] This paper explains in detail a simple and precise autonomous car parking system algorithm for Ackerman steering configuration. A two part trajectory planning algorithm consist of steering planning and simple distance calculation.

E. DiGiampaolo, etal.[3] In this paper a global localization system combining odometry data with radio frequency identification(RFID) reading is proposed. RFID tags are placed at the ceiling of the environment and can be detected by a mobile robot unit travelling below them. RFID tags are detected by using suitable tag's antenna in ultra high frequency band. They also used Kalman filtering approach for RFID tag detection. This application used used in several industrial and domestic scenarios.

R. Kaur,etal[4] To overcome traffic problem A FPGA based parking system has been proposed. In this paper, parking

system is implemented using Finite State Machine modelling. The system
has two main modules i.e. identification module and slot checking module. Identification module
identifies the visitor. Slot checking module checks the slot status. These modules are modelled in HDL and implemented on FPGA. A prototype of parking system is designed with various interfaces like sensor interfacing, stepper motor and LCD.

III. ALGORITHM

Image Processing:

Image Processing is a technique to enhance raw images received from cameras/sensors placed on some height and Pictures taken in normal day-to-day life for various applications.

Image is defined as 2-dimentional function f(x, y) where x and y are spatial co-ordinates and amplitude of f at any pair of co ordinate (x, y) is called intensity or gray level of the image at that point. When x , y and intensity values of f are all finite discrete quantities then image is called digital image. A digital image is composed of a finite no of elements each of which has a particular location and value. The elements are called pictures, image elements, and pixel.

The controlling of UGV takes place by image processing and FPGA. The basic operation of controlling UGV is when vehicle enters in the parking area camera will capture image of target object. The image is processed in the MATLAB. Different operations takes place on the image such as vertex identification, shape reconstruction and pose estimation, image correction and vertex projection. Image is captured by using camera which is placed at some height compare to target object. Binarization of captured image takes place in which each pixel is represented by 1 or 0. The main use of binarization is to reduce data buffering requirement. In next step erosion takes place in which noise is eliminated and preserve only pixels corresponding to colours.

Overview of FPGA:

FPGA is a field programmable gate array. It is reconfigurable integrated circuit. The FPGA configuration is generally works using a hardware descriptive language or verilog. The FPGA is made up of large no of (configurable logic blocks) distributed in programmable wiring matrix surrounded by programmable I/O blocks. As FPGA is a reconfigurable device it can support a growing no of standard signals. In most FPGA logic blocks consist of memory elements which may be simple flip flop or more complete blocks of memory. This FPGA works with Xilinx software.

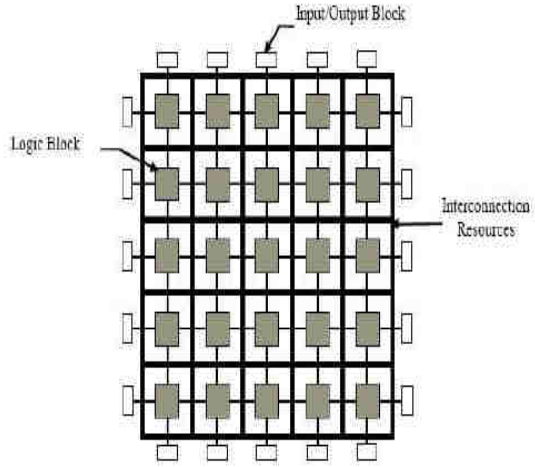

Fig.1: The structure of FPGA

IR sensor:

IR sensor is used for obstacle detection. It is connected to one of PIN of FPGA. This IR sensor has two parts transmitter and receiver. Infrared transmitter is a light emitting diode which emits infrared radiation. IR receiver comes in the form of photodiode and phototransistor. They detect the radiation of IR transmitter. This IR sensor operates at supply of 5V and consumes current about 3mA to 5mA.

DC motors:

DC motor is any class of electrical machine that converts direct current electrical power into mechanical power. DC motor has 30 RPM and 12V power supply. DC motors move according to the signal received by FPGA from PC.'F','L','R','B' is used to move robot forward , left, right, and back. All controlling of DC motor takes place through FPGA and MATLAB.

RF protocol:

An RF protocol is a small electronic device used to transmit or receive radio signals between two electronic devices. Frequency range is 2.4 GHz and its range is 10m range.

Stepwise operation:

Step 1: Start Camera

Step 2: Capture image of robot to identify its position

Step 3: Image of robot with red marker available

Step 4: Draw pixel path

Step 5: Convert pixel path into string

Step 6: Transmit string of data through RF protocol

Step 7: Robot control via FPGA and MATLAB.

IV. DESIGN AND IMPLEMENTATION

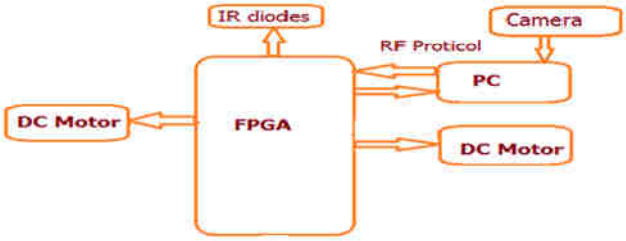

Fig. 2: Block Diagram

As shown in the block diagram FPGA is used as a controller. Camera is placed at the ceiling. The resolution of captured image is 640*420. The captured image processed in the MATLAB. While designing robot red marker is placed at the top of robot as shown in figure. To give path the co-ordinates of red marker is identified, then path is given to the robot by selecting pixels.Following GUI is generated to give path to the robot.

Fig.3: Red marker

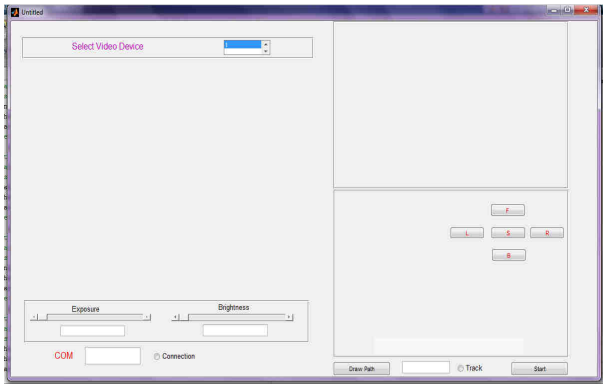

Fig.4: GUI of UGV

Now IR sensor is used to detect obstacle. IR sensor is connected to the one of pin of FPGA. When any obstacle detected 1 signal transmit to the FPGA and FPGA stop the running robot by sending signal back. RF protocol used for communication between FPGA and PC. The path given to the robot is transfer to the FPGA by using RF protocol. This data is transmitted in the form of bit.Here because of FPGA no need of external RF protocol due to presence of UART. This UART transmit at a time 8 bit data. DC motors move according to the signal given to this robot.This motors works on 12 V supply with 30RPM.

V. PRACTICAL REALIZATION

Hardware and software implementaion of UGV is ashown below.

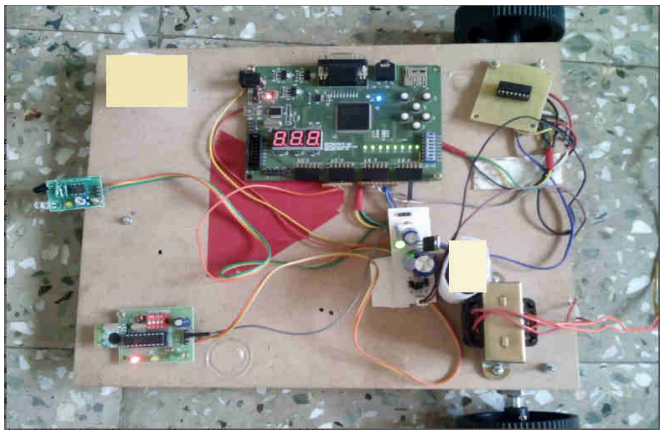

Fig.5: Hardware implementation of UGV

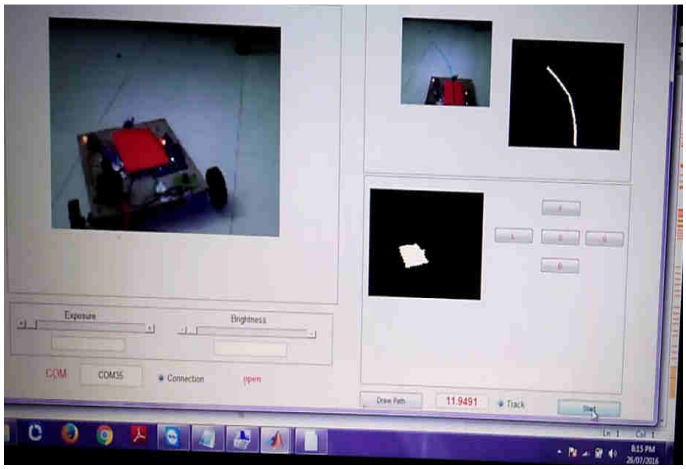

Fig.6: Software implementation of GUI

VI. CONCLUSION

A simple, flexible, low cost system has been presented to localize robot automatically. Due to use of reconfigurable FPGA it is so flexible and support new technology also. This system takes most advantages of software and hardware to perform specific task. Due to use of IR sensor it is possible to avoid any damage or accidents.

VII. FUTURE SCOPE

There is always chance of improvement in every work to make it more effective and for best result. In our system to make it more functional we can use no of camera to cover maximum area. Pressure sensor can be used to give accurate results but it is so expensive. At different location we can use sensors to detect presence and absence of UGV. RFID tag can be useful for the security purpose. No of new ideas can be merged to create project more functional.

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Biographies

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