A Review Paper on "UNMANNED GROUND VEHICLE"

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***Abstract*- Some of the most prominent problems facing the world today are Terrorism and Insurgency. Governments and scientists across the globe are working day and night in order to bring these problems under control. Billions of dollars are spent by nations for the research of new defense systems which are capable of safeguarding citizens from terrorist threats.**
Nowadays with major advancements in the field of vehicle automation, several dangerous and crucial counter terrorist operations are being handled by sophisticated machines which are not only more efficient but are also responsible for saving several human lives.
Our project "Unmanned Ground Vehicle" is built to undertake missions like border patrol, surveillance and in active combat both as a standalone unit (automatic) as well as in co-ordination with human soldiers (manual). It is a prototype illustrating the ever-expanding need for sophisticated technology and precision driven vehicles catering to the present day needs for a first line of defense. A person from a remote place can comfortably control the motion of the robot wirelessly and in situations where manual control is not prudent, the vehicle is capable of reaching the pre-programmed destination on its own.
This defense system of ours has two units- one is the control unit (to control mobility) and the other is the motion tracking unit. This robot would be a remote operator would be getting a live video feed from the camera to help him manually control both the above-mentioned units of the rover. The rover is also capable of automatically tracking movement of objects in its range of vision.
The rover is controlled by a human operator and live video is fed back to the base station. The turret will follow the movement of a joystick or a mouse. There is an additional ARMCON controller which helps the soldier on war field to control the rover using wireless modem.

***Index terms*- Border patrol, Insurgency, live video, Mobility, Prominent, Surveillance, Terrorism, terrorist threats, tracking unit, Vehicle automation etc.**

I.INTRODUCTION

Robotics has helped humans greatly in achieving everyday tasks. Robots are designed to work in any environment and perform task on behalf of humans. They operate under real-world and real-time constraints where sensors and effectors with specific physical characteristics have to be controlled [1].An unmanned ground vehicle (UGV) is a vehicle that operates while in contact with the ground and without an onboard human presence. UGVs can be used for many applications where it may be inconvenient, dangerous, or impossible to have a human operator present.

Unmanned mobile robots are actively being developed for both civilian and military use to perform dull, dirty, and dangerous activities. They proved to be effective in a large number of circumstances where the use of human labor is too expensive, the task is risky, or it is impractical for human capability [2].The robustness, range and security of the communication link between the remote base station and the UGV, obstacle avoidance must be taking into consideration. Taking the surrounding environment readings by a large number of sensors and process these data to form a clear picture to achieve the greatest benefit of UGV [5].

There is a wide variety of Tele-operated UGVs in use today. Predominantly these vehicles are used to replace humans in hazardous situations. Examples are explosives and bomb disabling vehicles. Generally, the vehicle will have a set of sensors to observe the

environment, and will either autonomously make decisions about its behavior or pass the information to a human operator at a different location who will control the vehicle through teleoperation.

An UGV is a mechanical machine capable of ground locomotion. Ideally, any UGV has the objectives of perceiving the environment around it through the aid of sensors, localizing itself within this environment utilizing software algorithms, building a map of its surroundings if the map is not a prior, planning its motion, and producing the motor commands necessary to follow a specific path. These commands vary significantly with the drive system employed, the wheel or leg set used for the machine and the feedback mechanism used. As such, it becomes quickly apparent that the wealth of resources and design options that could be utilized in a UGV design can be overwhelming [4].

II. RELATED WORK

A. Pibot: The Raspberry Pi Controlled Multi Environment Robot for Surveillance & Live Streaming

This complete model of Pibot will be connected to the local network and can be controlled via anyone, anytime, & anywhere. This Local network can be any place like home, office, prisons or for that matter anywhere which needs to have a temporary surveillance or a continuous one just plugs it in the network and the robot is good to go. This connection will be done via wireless network made, created or available at that place and made available to pi via Nano Wi-Fi adapter. The live streaming is being done by the help of MJPEG Streamer. It will be installed in the pi and then initializing the camera module. This camera module is the one designed by the raspberry pi organization for raspberry pi specially. It's a 1080p 30fps 5megapixel camera.

The MJPEG Steamer uses the concept of time lapse photography to stream the video. It takes photos at a periodic interval and them overwrites one over other to make it look like a continuous stream of video. Due to the computational power of pi we have to choose this method for streaming video [6].

B. Development of Communication Framework for Unmanned Ground Vehicle

This paper presents design an Unmanned Ground Vehicle (UGV) Navigation, which has the ability to drive by itself. The control system uses GPS, digital compass and laser range finder for effective navigation. The system consists of an adaptive steering control, throttle and brake system to assist the smooth motion control of UGV. The discrete PID algorithm with anti-windup was applied for DC motor position control tuning. Experimental results show that the proposed method can successfully navigate the UGV by way points as well [7].

C. Heuristics-enhanced dead-reckoning (HEDR) for accurate position tracking of tele-operated UGVs+

This paper introduces a new approach for precision indoor tracking of tele-operated robots, called "Heuristics-Enhanced Dead-reckoning" (HEDR). HEDR does not rely on GPS, or external references; it uses odometry and a low-cost MEMS-based gyro. Our method corrects heading errors incurred by the high drift rate of the gyro by exploiting the structured nature of most indoor environments, but without having to directly measure features of the environment. The only operator feedback offered by most tele-operated robots is the view from a low to the ground onboard camera. Live video lets the operator observe the robot's immediate surroundings, but does not establish the orientation or whereabouts of the robot in its environment. Mentally keeping track of the robot's trajectory is difficult, and operators easily become disoriented.

Our goal is to provide the tele-operator with a map view of the robot's current location and heading, as well as its previous trajectory, similar to the information provided by an automotive GPS navigation system. This frees tele-operators to focus on controlling the robot and achieving other mission goals, and provides the precise location of the robot if it becomes disabled and needs to be recovered [8].

III. PROPOSED SYSTEM

SYSTEM ARCHITECTURE

A UGV can be viewed as a Mechatronics system that integrates mechanical, electrical, computer and control engineering solutions

A UGV can be viewed as a Mechatronics system that integrates mechanical, electrical, computer and

control engineering solutions. Three main considerations affect the design of such a system. Namely, development cost and time, UGV capabilities and features, and lastly, the quality and reduction of bugs in system as a whole [4].

The commands are sent over to the UGV remotely using wireless communication such as RC or RF, while it transfers live video feedback to the user.

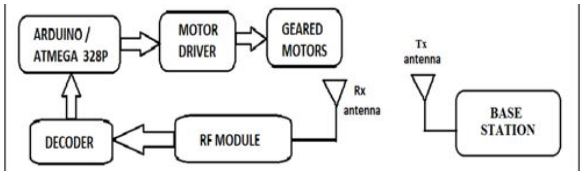

Fig 1: UGV Control System Block Diagram

Base station is a computer system located at a remote place away from the UGV which controls it using the keyboard, mouse for mode control and movement and live video feedback for monitoring the environment. And it also contains a transmitter circuit [2].

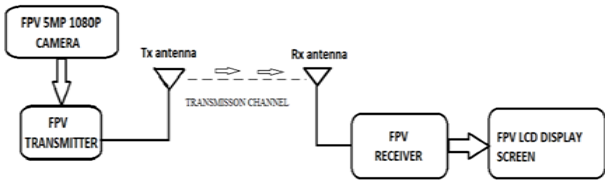

Fig 2: UGV Video Transmission and Receiver Block Diagram

The computer receives the data from UGV and displays it on a graphical user interface (GUI)/Display for the operator to understand the environment easily. This is a full-duplex communication. The operator at any time issues the command from computer which microcontroller installed on UGV receives through Transmitter module and after processing micro-controller issues the command to motor drivers accordingly [2].

The FPV monitor is simply a small screen used to view the live video feed from the ground. They are usually small so they can be powered by a battery and used in remote places. Some FPV monitors have integrated video receivers and digital video recorders. Since an FPV signal is commonly lost and regained sporadically, a monitor used for FPV should not change the configuration or turn off when it detects the signal that has been lost.

MECHANICAL DESIGN

There exists a wide range of options for UGV mechanical design for locomotion, each option comes with its pros and cons. For example, a differential drive is a simple option that utilizes a separate motor for each of the two wheels; however, for straight line travel and exact angle rotation, a feedback system has to be applied to the motors to obtain the speed of each motor and apply the required calculations. Other mechanical designs such as the synchro and dual differential, utilize a motor for forward drive and another separate motor for turning. These designs have the mechanical certainty of driving in a straight line; however, they have the disadvantage of complex design and efficiency loss due to the use of gears [5].

In our design, using six motors drive gives us a higher torque with an easier control. Furthermore, we can obtain a zero turning radius, in other words in can spin 360 degrees around its neutral axis, with the application of our control algorithms. The location of the center of mass is important, as it reduces required torque and power if chosen to be close to the axis or rotation.

Fig 8.1: 3D Design

CONTROL SYSTEM DESIGN

The control system design interconnects several processors, sensors, and actuators that communicated via USB, Serial, and I2C protocols [3][5]. The components also operate at various voltages, including: 12V for drive motors; 3.3V for microcontrollers, and wireless chips; 12V for the high-level computer.

Control system design includes the basic electrical components in UGV to provide the efficiency for operation and control [5]. The main requirement for electrical design is to extend operating time, provide constant reliable voltage to motors and other electronics, condense power supply into a single unit and deep-cycle battery. we use many components those are follows:

A. Arduino Microcontroller

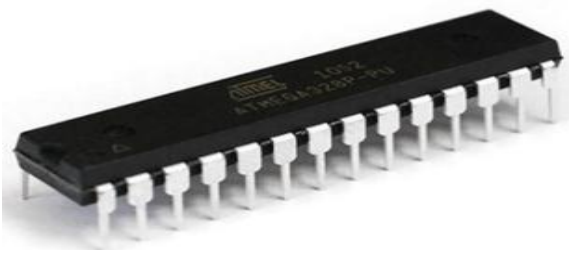

Fig 3: Arduino Uno Microcontroller (ATMEGA-328P)

"Arduino is open-source electronics prototyping platform based on flexible, easy-to-use hardware and software." The open-source Arduino environment makes it easy to write code and upload it to the i/o board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing, Avr-GCC, and other open-source software.

B. Gear Motor

Fig 4: DC Gear Motor

A gear motor is a specific type of electrical motor that is designed to produce high torque while maintaining a low horsepower, or low speed, motor output. Gear motors can be found in many different applications, and are probably used in many devices in home.

"Gear motor" refers to a combination of a motor plus a reduction gear train. These are often conveniently packaged together in one unit. The gear reduction (gear train) reduces the speed of the motor, with a corresponding increase in torque. Gear ratios range from just a few (e.g. 3) to huge (e.g. 500). A small ratio can be accomplished with a single gear-pair, while a large ratio requires a series of gear reduction steps and thus more gears. There are a lot of different kinds of gear reduction.

C. RC Transmitter & Receiver

Fig 5.:RC Transmitter & Receiver

Radio control (often abbreviated to R/C or simply RC) is the use of control signals transmitted by radio to remotely control a device. Radio control is also used for control of model vehicles from a hand-held radio transmitter. Industrial, military, and scientific research organizations make use of radio-controlled vehicles as well.

RC Transmitter & Receiver Specification

- Band-Range: 2.4055 – 2.475GHz
- Charging Port: Yes
- Low Voltage Warning: Yes (at less than 9V)
- No. of Channels: 6
- Operating Voltage12V DC (1.5AA x 8 Battery)

D. FPV Camera

Fig 6: FPV Camera

First-person view (FPV), also known as remote-person view (RPV), or simply video piloting, is a method used to control a radio-controlled vehicle from the driver or pilot's viewpoint. Most commonly it is used to pilot a radio-controlled aircraft or another type of unmanned aerial vehicle (UAV). The vehicle is either driven or piloted remotely from a first-person perspective via an onboard camera, fed wirelessly to video FPV goggles [2][3] or a video monitor. More sophisticated setups include a pan-

and-tilt gimbaled camera controlled by a gyroscope sensor in the pilot's goggles and with dual onboard cameras, enabling a true stereoscopic view.

FPV Camera Specification

- Sensor: 1/3 "CMOS
- Camera size: 28 * 24.5 * 17.5mm
- Electronic Shutter Speed: 1/50-1/100
- With lens cover, well protecting the lens
- Net Weight: 10.4g
- Super lightweight, low power consumption
- Lens: 2.8mm IR coated

E. FPV Transmitter & Receiver

Fig 7: FPV Transmitter and Receiver

An FPV Radio Transmitter is an electronic device that uses radio signals to transmit commands wirelessly via a set radio frequency over to the Radio Receiver, which is connected to an aircraft or multirotor being remotely controlled. In other words, it's the device that translates the pilot's commands into the movement of the multirotor.

FPV Camera Transmitter Specification

- Antenna Gain: 2db
- Frequency: 5.8GHz
- Power Input: 7.4-16V
- Working Current: 220mA at 12V
- Transmitting Range: up to 5km in open ground

FPV Camera Receiver Specification

- Antenna Gain: 2db
- Antenna Impedance: 50Ω
- Video Format: NTSC/PAL auto
- Power Input: 12V.
- Working Current: 200mA max
- Weight: about 85g

IV.ACKNOWLEDGMENT

First of all, we would like to thank Head of Electronics & Telecommunication Engineering Department, to give us the opportunity to work on proposed system.

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