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Ramps: Defence Robot for Border Security Using Raspberry-Pi

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ABSTRACT

The system proposed in this project consists of a single unit, which will monitor the environment in various hazardous conditions and provide live feedback. Basics of robotics like sensors and actuators, gives an overview on robotic construction. The proposed system is also able to capture real-time images which are useful for surveillance for a specific person or area. Controlling of Robot is done using a Raspberry Pi processor. This robot is more comfortable for military applications such as surveillance of interested area. It will provide tactical advantage during hostage situations or in hostile grounds. It is capable of walking on any surface and providing monitoring over an area. With the help of live sensor output transmission, the surveillance become more effective and it detect the temperature, Humidity, Movements of Human. These will prove important in applications like robots for civil use and military robots.

Keywords—Robot, Boarder Security, Raspberry-Pi, GSM

I. INTRODUCTION

The implementation of this project is to resolve the problem of replacing a human army with wireless controlled Omni directional monitoring robot with video support that completely controlled with wireless network. The project is to detect an object that is located at some distance within the range of RF transmitter with wireless camera. This vehicle is equipped with a metal detector can detect any land mine on its way, and wireless camera which will transmit the live pictures and videos remotely. This robot is also having a metal detector sensor, which will sense the presence of any mine in the survey area. It also having a magnetic field detector which will detect any presence of the magnetic field. A moisture sensor is also placed on it, which will detect the presence of any moisture or we can say water in the survey area. This is the powerful technique which is used to at the terrestrial site to check if any water contents are present. It is also having a light sensor, which will sense the intensity of the light. When this intensity will fall below a certain value, it will automatically make the IR lights on to make the camera night vision. One more powerful tool is GSM module. If by mistakenly the robot will move out of range of RF signal, then we will make the GSM module to work and make a call to the robot to get back in the range of RF. This unit is helpful and useful for surveillance of an

area in defence grounds for enemy, spying purpose where the human reach is not recommended or avoided. The unit is small handy portable and can reach places easily. At present the surveillance of International border areas is a difficult task. The border guarding forces are patrolling the border seriously, but it is not possible to watch the border at each and every moment. An essential requirement of this situation is a robot which automatically detects trespasser in the border and report nearby board security control unit. Many of the military departments now utilize the robots to carry out risky jobs that cannot be done by the soldiers. In this present work, a Raspbian operating system based spy robot platform with remote monitoring and control algorithm through Internet of Things (IoT)has been developed which will save human live, reduces manual error and protect the country from enemies. The spy robot system comprises the Raspberry Pi (small single-board computer), night vision pi camera and sensors. The information regarding the detection of living objects by PIR sensor is sent to the users through the web server and pi camera capture the moving object which is posted inside the webpage simultaneously. The user in control room able to access the robot with wheel drive control buttons on the webpage. The movement of a robot is also controlled automatically through obstacle detecting sensors to avoiding the collision. This surveillance system using spy robot can be customized for various fields like industries, banks and shopping malls.

II. SURVEY ON SURVEILLANCE ROBOT METHODOLOGY

Raspberry Pi based automated robot [1] S M Ashish, Madhurya Manjunath, Ravindra L, Mohammed Nadeem, Neelaja K [2018] proposed a concept about a Raspberry Pi based automated robot which fulfils the purpose of surveillance. The robot provides autonomous movement around the facility where it is deployed and will move around the obstacles in its way by detecting them. It detects any kind of human emotions in the facility and alerts the registered users through SMS alert. It also captures the image of the commotion by using a Pi camera.
Human controlled Spy robot [2] T. Saravanakumar, D. Keerthana, D. Santhiya, J. Sneka, D. Sowmiya [2018] The main objective of this paper is to develop a virtual environment for detecting suspicious and targeted places for the user without any loss of human life. It is based on the development of a robot vehicle for observing/spying suspicious objects. It can continuously monitor the objects. The robot can move in every direction (left, right, forward and backward). It is used for video surveillance and remotely controls the particular place using Wi-Fi as a medium. The webcam which is placed on the robotic unit will capture the video and it transmits lively to the remote end. The major application of this paper can be analyzed using an HTML web page which can be used to control the movement of the robot. L293D is a quadruple dual H Bridge motor driven IC.
Border surveillance and intruder detection using wireless sensor networks [3] D. Arjun, P. K. Indukala and K. A. U. Menon, "Border surveillance and intruder detection using wireless sensor networks represents the aim is to devise a multi-sensing system which is developed by combining different techniques of surveillance and intruder detection, for varying border scenarios such as, flat surface movement or water-body movement. Different sensors for human intruder detection such as, geophone, infrared and surveillance cameras are discussed.
Design and construction of a land wheeled autonomous mini-robot (LWAMR) for in-door surveillance Juan [4] G. Parada-Salado, Luis E. Ortega-García, Luis F. Ayala-Ramírez, Francisco J. Pérez Pinal [2018] presented a

concept on design and construction of a land wheeled autonomous mini-robot (LWAMR) for in-door surveillance. The LWAMR can be autonomous by using a position, speed and distance sensor. In addition, it is capable of sending images and video in real-time by using a spycam, which is controlled by a servomechanism.

III. PROPOSED METHOD

Figure 1 shows the methodology of the Robot movement. The Robot will move in particular direction based on IR sensors output, if left IR sensor gets active robot turns right and if Right sensor gets active robot turns left if both IR sensors are active Robot keep moving straight.

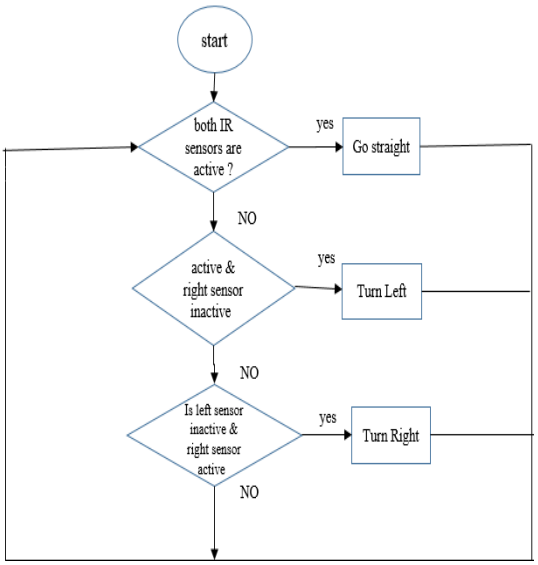


Fig 1: Flow chart for Robot Movement

Fig 2 shows flowchart for Gas, Temperature sensor upon reading the data of these sensors if any data present it displays the output if no it is again read the sensor data. Gas sensor senses the concentration of gases in atmosphere and it will be sent to cloud. PIR sensor is used to detect the human presence. Temperature sensor is used to measure the temperature of environment. System consists of two units mainly a robotic unit and a IOT unit. The Robotic unit consists of a microprocessor, the microprocessor here is the raspberry pi forming the central control of the system which is connected to a cloud wirelessly. The system is driven by a motor and the power supply is provided by a 12v battery. The robot is designed to communicate with the user using portable units like laptops or smartphones. A web page is built with for observing the outputs and to analyze. The range of communication between the handheld devices and the robot is increased by connecting them to the internet using Wi-Fi technology. Fig 1.5.1 shows the flowchart of robot movement. The Pi board is mounted above the chassis and underneath the structure, 4 DC motors rated 150 rpm each is adhered. The motors are powered by a 9V battery source each and attached to wheels. A L293D Motor Driver is embedded with the Raspberry Pi to drive the DC motors. Raspberry Pi is coded with Python scripting language in relation to the circuit connections to control the robot in all directions. A Pi camera is interfaced with Raspberry Pi to give a live

video feed. System is equipped by different sensor each of different use, The IR sensor is used to sense the presence of obstacles and it automatically redirects its way in the obstacles, the PIR sensor detects the presence of living objects in and around all these are captured by a pi vision camera. The software part is the web application which displays the status of the IR, PIR sensor and the images captured by the pi camera is displayed on the screen on the webpage. The web application has an added advantage of storing the images captured and gives the detailed history of the pictures captured before.

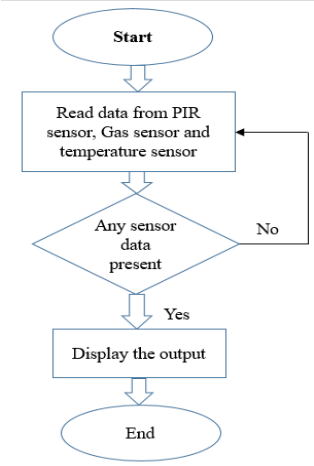


Fig 2: Flow chart for Gas and Temperature sensor

In Fig 3 Ultrasonic sensor and servo motor is used to build a radar, Ultrasonic sensor is placed on servo motor, Ultrasonic starts by sending the echo pulse and wait for echo back if echo is received back at receiver, then an object is detected then we will find the distance and speed of the object, if no object detected then servo motor start to rotate. After detecting object, the speed and distance is sent to cloud. Which can be accessed by the army base station.

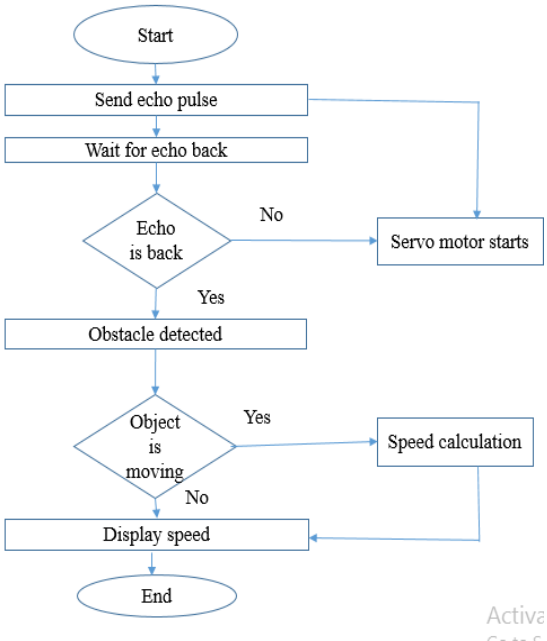


Fig 3: Flow chart for Radar

IV. IMPLEMENTATION

Block diagram for system is given in below Fig 4.

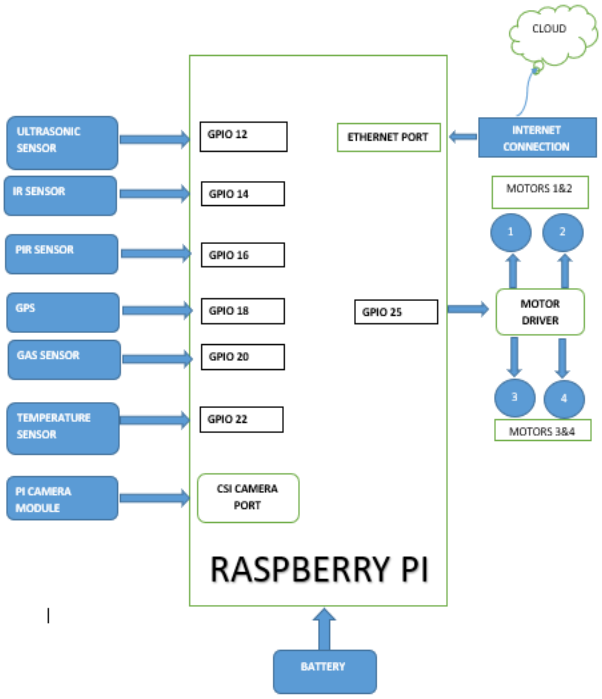


Fig 4: Block diagram for the system

1. Raspberry Pi 3B+ (RPi): Raspberry pi is microprocessor which is used for processing the inputs. The Raspberry Pi is the cheapest board, it doesn't have a case, and is simply a credit-card sized electronic board of the type which might be inside a PC or laptop but much smaller. It acts as the controlling core of the system.
2. Pi Camera: The Pi camera module is a portable light weight camera this supports raspberry pi. It communicates with Pi using MIPI camera serial interface protocol. It is normally used in Image processing Machine learning or in Surveillance project.
3. Ultrasonic Sensor: Ultrasonic sensor use to transforms the electrical energy into acoustic waves or sound waves and conversely. An ultrasonic wave is also an acoustic wave signal which is travelling at a frequency more than 18kHz. The generation of ultrasonic waves at 40 kHz frequency is done by HC SR04 ultrasonic sensor.
4. IR sensor: An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment
5. PIR sensor: A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view.
6. Gas sensor: Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration.

7. Temperature sensor: A temperature sensor is a device used to measure temperature. This can be air temperature, liquid temperature or the temperature of solid matter.
8. GPS: GPS sensors are receivers with antennas that use a satellite-based navigation system with a network of 24 satellites in orbit around the earth to provide position, velocity, and timing information.
9. Motors: An electric motor (or electrical motor) is an electric machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding. This interaction generates a force in the form of torque which is applied to the motor's shaft.

V. DETAILS OF THE PROPOSED SYSTEM MODULES

A. HARDWARE required

1. Raspberry Pi Model 3B+ Microprocessor

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting a 64- bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT The dual band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market. The Raspberry Pi 3 Model B+ maintains the same mechanical footprint as both the Raspberry Pi 2 Model B and the Raspberry Pi 3 Model B.

2. PI Camera Module

Raspberry Pi Camera module is used to take pictures and high-definition video and the CSI (Camera Serial Interface) interface connects the Pi Camera module with the controller board directly. The Pi camera has a resolution – 5 MP with HD Video recording in 1080p @30fps, 720p @60fps, 960p @45fps and so on. It can also capture wide, still (motionless) images of resolution 2592x1944 pixels. The images are flipped horizontally or vertically and also a change in image quality parameters such as brightness, contrast, saturation and sharpness and access advanced camera features to improve image effects. These features of camera are used to capture the image of smugglers infiltration in dense forest.

3. Ultrasonic sensor

It detects the objects or any obstacles present while moving. It is also used to measure the distance between the object and the robot by sending ultrasonic waves. These waves have frequencies that are beyond the normal hearing frequencies. It consists of two transducers one is the transmitter and the other is the receiver.

4. IR sensor

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. An IR sensor can measure the heat of an object as well as detects the motion. Usually in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect this radiation.

5. GPS Module

Global Positioning systems are capable of precisely locating objects by utilizing the RF signals from the satellites. GPS module is needed in the project to update the location to the Firebase platform whenever the

threshold temperature set is exceeded. U-blox NEO-6M GPS module is interfaced with the Raspberry Pi to achieve the desired operation.

6. Passive Infrared Sensor

Passive Infrared Sensor (PIR sensor), identifies the changes in the radiation which is generated by warm-blooded motion objects The PIR sensor made of two slots, which is sensitive to IR. When the sensor is idle, both slots identify the same amount of IR which is radiated from the room or walls or outdoors. The human or animal interference causes a positive differential change. When the interference has crossed the sensing area a negative differential change occurs.

7. LM73 Temperature sensor

Texas Instruments LM73/LM73-Q1 Temperature Sensors are integrated, digital-output temperature sensors featuring an incremental Delta-Sigma ADC with a two-wire interface that is compatible with the SMBus and I2C interfaces. The host can query the LM73/LM73- Q1 at any time to read the temperature. These devices occupy very little board area. The LM73 operates over a –40°C to 150°C temperature range and provides ±1°C accuracy from – 10°C to 80°C. While the LM73-Q1 operates over a –40°C to 125°C temperature range and provides ±1.45°C accuracy from –10°C to 80°C.

8. Gas Sensor

This is MQ-9 Carbon Monoxide, Methane, and LPG Gas Sensor Module can be used to sense Carbon Monoxide and Methane Gas. Sensitive material of the MQ9 gas sensor is SnO2, which with lower conductivity in clean air. It makes detection by the method of cycle high and low temperature, and detect CO when the low temperature (heated by 1.5V). The sensor's conductivity is higher along with the gas concentration rising. When a high temperature (heated by 5.0V), it detects Methane, Propane, etc. combustible gas and cleans the other gases adsorbed under low temperature.

9. DC Motor

Four DC motors are connected to the Raspberry Pi to convert the electrical energy into mechanical energy and rotate the wheels. The motors used in the system operate at a speed of 150 rpm.

10. Servo Motor

A servomotor (or servo motor) is a simple electric motor, controlled with the help of servomechanism. If the motor as a controlled device, associated with servomechanism is DC motor, then it is commonly known as a DC Servo Motor. If AC operates the controlled motor, it is known as an AC Servo Motor. A servomotor is a linear actuator or rotary actuator that allows for precise control of linear or angular position, acceleration, and velocity. It consists of a motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

11. Motor Driver

A motor driver IC based on the concept of H-Bridge is utilized. The DC motors of the robot are driven by a motor driver utilizing an external 9V supply. This driver receives the signal from the processor and controls the speed of the motors.

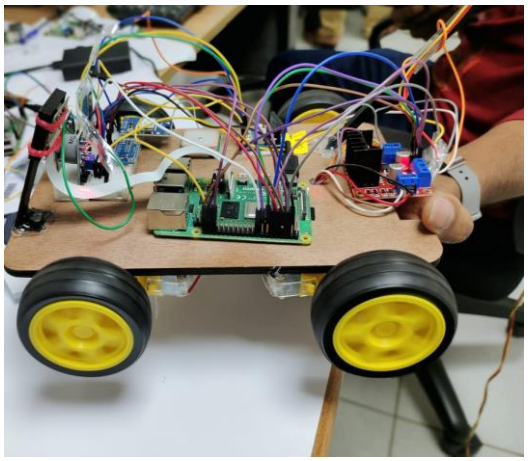
B. SOFTWARE REQUIRED

1. Raspberry Pi OS

Raspberry Pi OS (formerly Raspbian) is a Debian-based operating system for Raspberry Pi. Since 2015, it has been officially provided by the Raspberry Pi Foundation as the primary operating system for the Raspberry Pi family of compact single-board computers. The first version of Raspbian was created by Mike Thompson and Peter Green as an independent project. Raspberry Pi OS is highly optimized for the Raspberry Pi line of compact single-board computers with ARM CPUs. It runs on every Raspberry Pi except the Pico microcontroller. Raspberry Pi OS uses a modified LXDE as its desktop environment with the Open box stack window manager, along with a unique theme.

VI. RESULT

The essential point of the surveillance robot is that it has the various capabilities of detecting and sending the signals to the authorized user from different environments. This project is very beneficial and convenient for the places where human access is impossible and life threatening. This proposed design used for security purpose can operate effectively in order to collect various types of information that required by users



VII. FUTURE SCOPE OF THE PROJECT

To fully exploit the potential of advanced technology, i.e., IoT in the coming years, more research would be done in both protocol development, energy efficiency, more sensors integration, and integration of long wireless communication modules. The present work can be extended by adding unusual event detection in order to recognize the activities of unknown or known person. As algorithms used in image processing are illumination affected, advanced algorithm can be deployed to insulate the robot from light effects.

VIII. REFERENCES

[1]. Prof. Javaid Khurshid, Hong Bing-rong “Military Robots – A Glimpse from Today and Tomorrow” 8th International Conference on Control, Automation, Robotics and Vision Kunming, China, 6·9th December 2004

[2]. Ghanem Osman Elhaj Abdalla, T. Veeramanikandasamy "Implementation of Spy Robot for A Surveillance System Using Internet Protocol of Raspberry Pi" 2nd IEEE International Conference On Recent Trends In Electronics Information & Communication Technology, May 19-20, 2017, India.

[3]. Shubham Mittal and Jaynendra Kumar Rai "Wadoro: An Autonomous Mobile Robot for Surveillance" 1st IEEE International Conference on Power Electronics. Intelligent Control and Energy Systems (ICPEICES-2016).

[4]. P. A. Dhulekar, Dr. S.T. Gandhe, NachiketSawale, Vikas Shinde, Sunil Khute "Surveillance System for Detection of Suspicious Human Activities at War Field" 2018 International Conference On Mukt Shabd Journal Volume IX, Issue VI, JUNE/2020 ISSN NO: 2347-3150 680

[5]. R. Ikhankar, V. Kuthe, S. Ulabhaje, S. Balpande and M. Dhadwe, "Pibot: The raspberry pi controlled multi-environment robot for surveillance & live streaming," 2015 International Conference on Industrial Instrumentation and Control (ICIC), Pune, 2015, pp. 1402- 1405 Columbus, OH, 2014.