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Prototype for Design and Development of Video Surveillance Robot

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Abstract: - This paper proposes a method for the surveillance in the vicinity of the armed forces where there is exposure to intruders/prosecutor throughout. The Video Surveillance Robot is designed in such a way using the IoT (Internet of Things) it can give an overview of the operations all over. The armed forces require 24×7 vigilance, which is not feasible for human because of invasion of the intruders, which is extensive at times. In earlier days, the robots were composed with an unreliable approach that it had several limitations comparably of expenditure, magnitude, confidentiality, connection and manual surveillance. So, the wireless Video Surveillance Robot plays an essential role in armed forces and becomes a helping hand to the military personnel. The Video Surveillance Robot provides continuous live video streaming of the area on a Webpage or mobile phone with the help of a web camera. And the pi camera captures the images of circumstances and simultaneously uploads them on the Cloud. The ultrasonic sensors detect the obstacle in the lead and find the most extended pathway for continuous supervision. The exclusive Video Surveillance system is implemented on Raspberry Pi3, which includes the Raspbian Operating System, and it operates with the language Python to write a program for numerous segments for the robotic system.

Keywords: Raspberry Pi 3, Power battery, L293D, Ultrasonic sensor, Video surveillance, Web camera, Pi camera, Server motor, Webpage.

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1. Introduction

In the present era, the domain of robotics is flourishing exponentially, and a few of the prominent robotic products are used widely in the corporation, defence, academic and research association. The video analysis is the mechanism to supervise locus, territory or an individual. A condition like this mostly arises in armed forces where vigilance of outskirt region and in invaders province are crucial for the security of the region. A personal inspection can be achieved by authorizing military cadre bordering the vicinity to invigilate. But, humans are restricted to a certain extent, and surveillance in the region turns out to be unachievable. There is an exposure of losing military personnel life in such a lethal estate. Video Surveillance has marvellously resembled the exploration of the last few decades. Video Surveillance has a wide range of purposes like traffic monitoring, home automation, monitor operations, outdoor security, and internet security system and understanding human activity. With the advancement in the automation throughout the generation, it is feasible to invigilate the boundaries with affluence. Prior in the field of industrialization, the robots were restrained by a connected circuit but nowadays to incorporate and compose the robot beneficially, and they have been designed in order to reduce military personnel obligations which are reprogrammed faster and more efficient. In this project, we have acquired and established a Video Surveillance robot which is used for the surveillance of the proximity in the form of live feed & monitoring of military vicinity that is under control via a GUI that is a Webpage. Distance is not at all a constraint to transmit in this proposed system. Video Surveillance Robot is proficient enough to endeavour from far and wide in any place around the globe where there is a Wi-Fi or Internet affiliation.

The proposed surveillance system is decently capable, which benefits with the intent of safeguarding in armed forces, where the military cadre are demanded to gain a clue from the apprehensive zone, intruder, invasion, etc. This can be accomplished by being sedentary at a distant

shielded region in which armed forces can cautiously formulate the procedure to confront the activities of the prosecutors and plan the strategy accordingly. The video surveillance robot has ample perception to incorporate the neighbourhoods that the armed forces can equip the most extended pathway for continuous supervision. This robot can achieve selected tasks in unfavourable circumstances with or without any individual's guidance. Video Surveillance Robots is designed with high-resolution cameras which can monitor over the distant radius.

The robot achieves live feed from a web camera through a web browser on a webpage or a mobile phone. It also perceives the real-time image from the pi cameras, which directly transmits it to the Cloud. This transmitted image can be used for the analysis of the area, and strategies can be programmed subsequently. Also, these images could be achieved from any place around the globe with the available Internet connection. The robot is loaded with distinct sensors which can perform numerous functions. As the IoT, i.e. Internet of Things is a technology, which is recently popularized in the department of Information Technology. And this approach is about administration alongside benefiting hardware modules with the Internet and the preferred design for the relevance is Raspberry Pi. The model proposed in the following paper for Video Surveillance Robot incorporates the utilization of the affordable system, in association with the robot, wireless communication and competency of the regulating system and advanced controlled algorithm, robot control devices and new drivers.

2. Related Work

This segment states a detailed survey of a few approaches that have been prevailed, executed and tested for supervising the proposed system that is Video Surveillance Robot adopting Raspberry Pi. The author offers that the robot will play an integral part in the daily life of personnel for security purposes to reduce the period and increase the productivity of the task.

The video surveillance robot is to make it user-friendly the robot can easily detect suspicious activities and capture images and wirelessly transmit them, thus giving the military personnel intimation about the action in the proximity and dangerous intervention by the prosecutor so that it can be efficient to perceive and take necessary steps. And the movement of the robot will be done depending motor direction based upon the input given by the commander and the robot will give high-level images even in the low light. If there is human detection by the PIR sensor, it will send those images to the database through the Internet as per the order given by the commander. The efficiency of robot can be increased the efficiency so that mobility becomes fast and the robot can migrate from one place to another and accelerate also increase the night vision camera megapixels so that good clarity of images can be accomplished [1].

The author proposes that robots hinge over the statistics either on code which coming out of a system to assist the procedure, i.e., where there is no perceiving, estimation, and even the memory are combined towards a standalone operation. The Cloud Robot and even the Automation systems have been predominately characterized in the following aspect: The system of the robots entrust on the data which has been acknowledged by the network to reinforce particular application. Also, it has been predetermined to encompass forthcoming operations and tons of extant systems which are interconnected and teleported or else network operated for itinerant robots such as warehouse robots, home automated systems, and also for the systems which can permit with an estimation of performance through a creature. In retaliation to the systems dormancy, the fluctuating trait of the maintenance, and suspension, the robot generally comprises of the local processing for low-latency acknowledgement all the while where the network admittance is non-existent. Integration of the instinctive reinforces the confidentiality and the surveillance corporation on the Cloud [2].

Author proposes the idea of integrating the wireless sensor network via broadcasting with the cooperation of a video surveillance technology to yield superior vigilance assistance and also to transmit the operation of the proposed system. And indeed suggest a method for monitoring province. This system can seamlessly monitor the migratory object. The wireless sensor network can sense innumerable objective occurrences that shall amplify the stretch of vigilance which is rendered by conventional scrutiny approaches. With the assistance of this robot, instructions exchanged are capable of interpreting with the real-time photographs to estimate endeavour and workforce which is urgency and is tremendously deteriorated.

The robot demonstrates the representation of the system that can be enforced to distinctive circumstances. The function is attainable and equivalent as a classic supervision system with several upgradations and so that it can implement the indulgent activity evenly. The system suspension can result in derogatory circumstances because of the system investigation. The suspension of the system abides of assembling statics from the sensors, incident circumstances, also rotation time of the cameras [3].

Author proposed a system that is been constructed to establish a video supervising system, where it can capture the photographs and accumulate the video frames in an SD a card which will be braced on the robot for the supplementary

authentication. For the essential contribution of the system is the detailed functionality. The idea of incorporating media devices is essential for a forthcoming performance of the proposed function to accommodate with enhanced superintendence assistance. Including the usage of a smartphone, this entity could seamlessly invigilate the portable commodity.

Through adopting a web camera, the surveillance is transmitted by the robot, and it can be analyzed subsequently so that performance evaluation graph would show the system will be applied in numerous situations. This surveillance system covers only a particular direction it is impossible to turn to a specific direction based on priority. The sensory data collected using the gadgets remains unreliable and inadequately synchronized [4].

The author proposed the architecture and implementation for a nominal expenditure for the system which can monitor established on Raspberry Pi, and which operates on a single board computer that accompanies the motion apprehension algorithm. The innovation of the algorithm hinges on an inception assessment it means that the pursuance of the algorithm can be reinforced by taking into account definite circumstances. If there prevails an exceptional clarification to procure a suitable threshold profit and then the algorithm could encounter the eloquent substances specifically, in conjunction with gradually evolving or tiny objects.

The system is yet miles from the vitality of concluding the variant of a surveillance system, and it can be too advanced in abundance [5].

The author has proposed tracking robot which can be inhibited subordinately, and it will be efficient to take possession of a video from the vicinity, and it can also evade hindrance using ultrasonic distance sensor. This advanced mechanism of the tracked robot for surveillance has the proficiency to avoid the obstacle. This general-purpose robot can receive the algorithms and the commands from the remote controller and disincentive evasion to manoeuvre the video surveillance robot.

The experimented conclusion with discrete amplitude displays the glorious separation for broadcasting those commands which are not more than 20 meters. The image processing mechanism from the video and obstacle avoidance has recommended and demonstrated a commendable achievement. Thus robots may demand additional sensor to able to calibrate the distance of a obstruction in its vicinity. The fundamental part of this system is the deficiency of the variety of sensor is the interference amongst distinct sensors and the defined ability to identify the obstacle [6].

Author has advanced the task for secluded supervising prototype system by adopting a Wi-Fi controller which is impelled by a Raspberry Pi. Some distinctive hardware segments and their aggregation were illustrated by several applications which were supervised and analysed by virtue of approaches relating how the components could be unified so that it could correspond via the web interfaces. In the proposed system, the camera operates as the spectator so that it could administrate the vigilance and examine to catalogue the user during the time to subordinately manoeuvre the robot.

The live streaming of the system is implemented on the web interface of the video, which caters the user along with the exploration bureaucrat, which approves and regulates the robot migration. In this proposed project an entirely functional model can be adopted for the principle of surveillance in the proximity, or along the alarming field and in the similar divergent locality. Also, until a considerable extent, the enhancement is manageable to strengthen the competence of the project. The area of operation has been constrained to defined network coverage. Besides the camera of the system could be enhanced to accomplish a more exceptional quality to improve the excellence of live streaming [7].

They have developed an elongated extension composed robot which has an extensive utilization as well as a wide control of territory. It has been concluded to establish an introductory model and profitably can be controlled from an outstretched province which would be capable of contributing with the productivity of 74% with the consistency of 512 Mbps Wi-Fi or the Internet. To achieve this automatic perception of images, deriving from frame to frame to encounter various target and community. It is often desirable to establish a variety of target available from the photograph [8].

They have designed and implemented an economical, adequate and resourceful surveillance robotic system which can record/capture video or images and transmit that fundamental knowledge to the Internet as it has distinct supremacy as also exhibits authenticity and confidentiality. Along with its miniature magnitude and flexibility, it could be passed down to several kinds of vicinity for the supervision.

In the field where there is the existence of terrorist or ascetic actions which are further effectual in the field of defence, military, border security or several other kinds of safeguarding forces, in this manner of surveillance, tracking and the item demolition systems is enforced. The proposed robot effortlessly supervises by adopting a laptop or a smartphone. This system which is established on Raspberry Pi is a video surveillance robot which can be supervised from

all around in the globe over the Internet of Things (IoT). A Webpage is designed to administrate the displacement of the robot which is made to ensure by the exclusive user name and a password and which is not easy to be dogged by anyone conveniently. With the use of the Internet, there is a slight time lag occurring taking place, which depends on the category, acceleration and stretch of the network [9].

The author has proposed a piece of precise instruction for regulating the robotic system, which is accompanied via the Internet. The benefit has been done with the use of TCP and UDP protocols for the transport layer in the data transfer. The range of the images sent by the video surveillance robot is controlled, and feedback is sent back to the user for further analysis. This evaluation of signal will be regulated even if the proportion of the photographs sent is limited or enormous both depending on the upload speed is feasible with the Raspberry Pi, hence manufacturing it further vigorous to stream the live data along with the rewarding development of the robotic system proposed.

Rapid communication will secure that high quality, and high-resolution photographs can be sent with nominal delay or latency. This robotic system will serve to curtail prolong in the execution of commands handing over the real-time connection of the system. So that we could get immense benefit from the surveillance and all illegitimate activities taking place in the vicinity can conveniently examine. The counter might get distinct values, for the particular present the differences between successive time stamps. The stated value serves as the duration that is decisive to achieve voice commands [10].

Author has proposed a system that is been used for the brilliant robotic attendant which would be performing according to the voice and the gesture commands given to it. The voice and the gesture command which has been received by the robot is then transformed to the document format and then it is transmitted to the board which is then acquired by the user. And then it is been transmitted to the corresponding motors. Thus, after getting the commands from the motor the wheels are rotated. Then the wheels will perform the action and operate like a move towards to the right, move towards to the left, move in the forward direction, and the move in the backward direction. The robot can contribute to more advancement of the functions which are established on the Android Operating System. Such an application would behave the involvement of the various sensors on the system.

This would cater the gateway for an extensive dimension possible related operation like the automation of household functionalities and threatening expedition. Even rigour attention of its evolution could be enhanced by taking encoders in the error feedback path [11].

Author has proposed a resourceful surveillance entity using Raspberry Pi which is adequate for recording or either capturing the videos and the images that have been transmitted to a computer, laptop or a smartphone. This robot has been designed in adversely for regulating a robotic system which is concurrently guided via the Internet. Altogether this approach can be used in several circumstances where it is strenuous for the military personnel to attain. It invigilates the operation and guards the neighbourhood against the antagonist, and the surveillance is carried out by the robotic system throughout with enormous efficiency and also high precision. The web camera is assembled on top of the robot which will monitor the vicinity and transmit the video of the detected motion and also benefit us with storing the data in a server, and even the live video can be accessed from anywhere by merely entering static IP address which is assigned to the video surveillance system in the web browser or mobile phone.

To accomplish the automatic recognition of images, the meaningful use of the software tools is done to be proficient of recognizing patterns from frame to frame to encounter items and the individuals. In the smart image processing mechanisms which are the adequate tool for the critical decision making, and establishing a comprehensive and effective discourse of the events forth decision-maker, as well as the with the alarming system. The system compromises of the intelligent processing with the digital photographs which would significantly improve safety, by ensuring the constant recording of the events in the monitored area [12].

Author has proposed the competence of the technologies and how they have interspersed them into the system, and introduce the motion system which is inhibited by an android device and also it is how it is subsidized to the armed forces or organization. This system is an alternative preference and superior surveillance systems being used at the moment. This surveillance system does not desire any exclusive adaption in the framework although the only installation is required. This system has been creditworthy for more than 20 days and commenced to be 99% accurate to notifications and result [13].

Author has proposed a system in which the uncertainty of armed forces in the war zone has been abolished with this system. This system equips effective surveillance to military personnel by adapting the multiple sensors that have been re-established together to contour a cognitive robotic system which will be able to apprehend and broadcast the data and simultaneously anticipate the data which can be the form a piece of geographical information also theses sensor data which even includes atmospheric circumstances and the human detection which allows the benefit of messages so that the military personnel could

access all the real-time information synchronously and also address command from the headquarters using IoT. Since IoT has been used, the data will be shared at both ends (military personnel and the control room) such that accomplishing life reliable for the armed forces [14].

The author has proposed a system which can accomplish vigilance and is extensively utilized in monitoring. This system can be procured online and endure the current proceedings. This is used primarily for defence intent and also for few industries. It is an extensive expansion in surveillance purpose and even favourable in case of data storage through the robot. Using a webpage, the video recording can be accessed for the surveillance and using the control buttons the robot can be supervised concurrently [15].

The author has proposed a system where a spy robot used for armour proposition by which it can be operated efficaciously to compile distinctive categories of information requisite by all the users. For precedent, the presence or the absence of the undesirable personnel in the combat fields and also are forbidden in analogous areas which can be determined only by the PIR sensor which delegates the signal to the Raspberry Pi when there is a presence of the humans is in the ambient of the robot. In return, Raspberry Pi sends enactment and then triggers the camera module forthwith to acquire an image and then send it to the web page. All the controls room of armed forces collects this information for later implication [16].

3. Methodology

1. Initially set all motors off.
2. Set far and near parameter here we set 5cm.
3. Activate camera and other sensors.
4. Check front distance, if equal to set threshold, then initiate forward, backward action and move method action.
5. Check front distance, front right with far threshold and front left with near threshold, execute turn right action.
6. Check front distance, front left with far threshold and front right with near threshold execute turn left.
7. Check front distance, front right, front left with near threshold then execute backward.
8. The pi camera captures images of the vicinity every 5 second.
9. The images are uploaded on the Dropbox (Cloud) simultaneously.
10. That can be accessed by authenticated users from anywhere.
11. And these images can be used for further planning strategies.

In this research, we are using Motor Driver L293D by which speed and direction control is possible. The motor voltage consists of 4.5V to 36V and maximum motor current is approximately 1.2A and transmission time is 300ns. The Ultra Sonic sensor which operates on 5V which can measure distance 2cm to 80cm and gives the accuracy of 3mm and operating on current which is approx 15mA. The Pi Camera is 5MP coloured camera module which has MIPI Camera serial interface and resolution of 2592*1944 also supports 480,720p.

The threshold value is set up to 5cm to check the distance in all the directions that is forward, backward, left and right. It could detect the longest pathway using the sensor and then follow the path.Raspberry Pi3 Consist of the microprocessor of Broadcom BCM2837 which has CPU of 4× ARM Cortex-A53, 1.2GHz it has RAM of 1GB LPDDR2 (900 MHz) and networking of 10/100 Ethernet, 2.4GHz 802.11n wireless, Bluetooth 4.1 Classic, Bluetooth Low Energy and stores in micros and consist of 40-pin header, populated and has ports of HDMI, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI). The Web camera consists of 2592 x 1944 full resolution modes; it has frame rate of 8, 12 bits, pixel rate of 6-96 MHz and exposure range of 96MHz to 6MHz. Raspbian is a free operating system based on Debian, optimized for the Raspberry Pi hardware. Raspbian comes with over 35,000 packages: precompiled software bundled in a nice format for easy installation on your Raspberry Pi. Raspbian is a community project under active development, with an emphasis on improving the stability and performance of as many Debian packages as possible. The language used is Python for writing the code.

The pi camera capture images of the vicinity every 5 second and those images are simultaneously uploaded on the Cloud that is Dropbox. The images can be accessed from anywhere around the globe via the Internet. The image can be used further for Image Recognition using Tensor flow.

4. Results and Discussion

Figure 1: Hardware Module

The Figure 1 shows the hardware module of the Video Surveillance Robot.

It shows the various sensors, batteries, USB camera, and motor driver attached to the system.

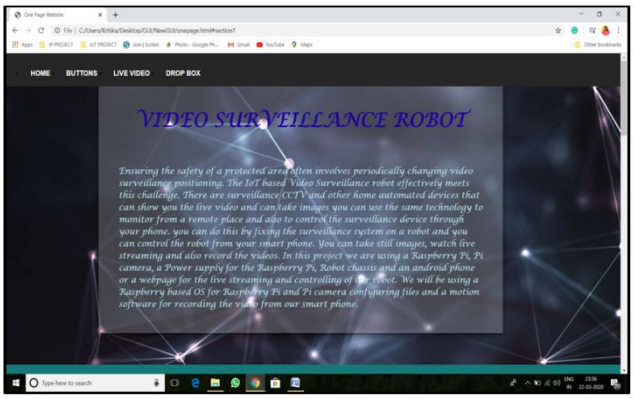

Figure 2: GUI Interface

The Figure 2 shows the GUI

i.e. Webpage where all the data can be accessed and controlled within the same page. There is a Home button which show the description of the system, with Buttons the movement of the robot can be controlled, with Live Video the live feed of the vicinity is displayed and with the Dropbox the cloud data can be accessed.

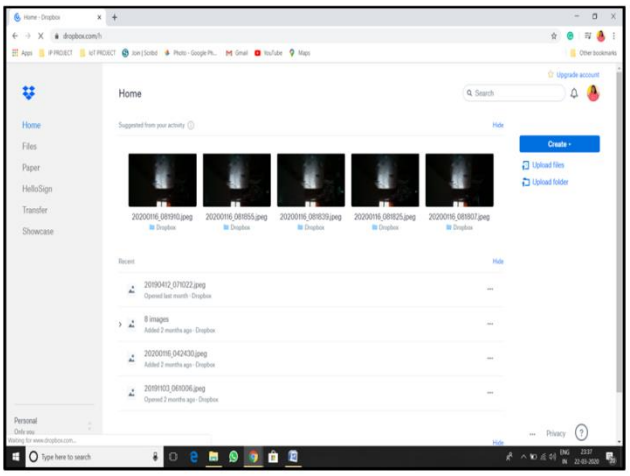

Figure 3: Data from Cloud

Figure 3 shows the data from the Cloud.

The pictures from Pi camera are simultaneously uploaded over the Cloud and can be accessed by the authenticated user.

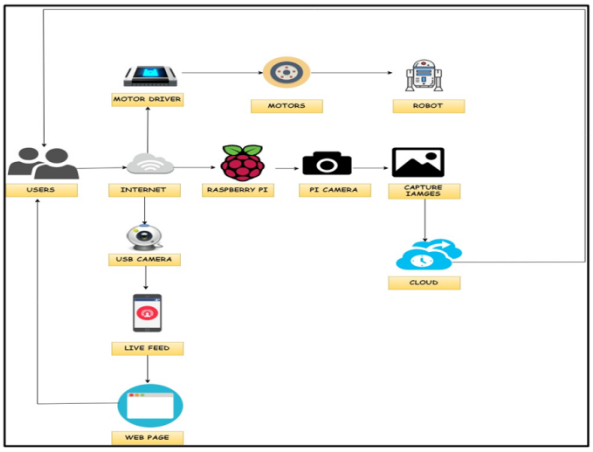

Figure 4: System Architecture for the Video Surveillance Root.

Figure 4 represents the system architecture of the Video Surveillance Robot.

In this the user has access to the Internet via the Internet Raspberry Pi is connected and the motor driver using motor is mounted on the Robot and Pi camera is mounted on the Pi it simultaneously captures pictures and upload them on Cloud. The USB camera provides with live feed on the Webpage. The user can access the Robot, Cloud and the Webpage.

TABLE 1
RESULTS FOR DISTANCE AND TIME

Sr no	Distance (in meter)	Data transmission time	Cloud processing time	Reply time from Cloud
1	25	8 sec	3 sec	1 sec
2	50	9 sec	3 sec	1 sec
3	75	8 sec	3 sec	1 sec
4	100	9 sec	3 sec	1 sec

We are storing data on Cloud, and we are processing received images using image recognition techniques.so videos captured by the camera, forwarded to Cloud and Cloud immediately respond to data.

5. Conclusion and Future Scope

Hence from the above discussion, we can conclude we have designed and then implemented a low-cost, competent, and resourceful Video Surveillance Robot which can cater us with a live feed of the vicinity on the Webpage also capture those images and simultaneously transmit them to the Cloud. Using the available and substantial microprocessors like Raspberry Pi 3 and various sensors, we could design this robot that can achieve superintendence for the armed forces. With intercede of multiple sensors, we are also able to percolate the Video Surveillance Robot also ineluctably, this surveillance system can be regulated remotely from all around the world. All this proficiency can be used in several circumstances and operations where it is strenuous for the armed forces to overtake. Also, because of its tiny dimension and manoeuvrability, it can be used in every surrounding for surveyance. We can further prolong this project by enumerating a few enhanced features which would make it more dynamic and impregnable. The images transmitted can be used for further analysis using Artificial Intelligence for face detection. Also, procreate it voice-controlled using Google Assistant so that it can be vocalized and connect to smart wearable which in return would give us exceptional outcome and demonstrate exceptionally

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