A REVIEW ON – SURVEILLANCE ROBOT USING RASPBERRY-PI TECHNOLOGY

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Abstract - This paper describes a Surveillance Robot scaling horizontal and vertical surfaces while automatically controlling surface transitions, and provides the controlling user with surveillance of its location. Unlike other wall-climbing robots currently available using vacuum suction technique and magnetic prosthesis, the proposed model is also capable of capturing real-time images, video and audio to provide surveillance for a specific person or area. A Raspberry Pi processor is used to control the robot via a Zig-Bee network for uninterrupted data processing and transmission. This robot is suitable for military applications like monitoring a person or area of interest, providing tactical advantage in hostile grounds or during hostage situations. It is capable of walking on any surface and providing monitoring over a area with the help of image processing which is capable to analysis and manipulation of a digitized image, video. The proposed system consist of a single unit, which will monitor the Environment for various hazardous conditions and provide video feedback.

Keywords: Raspberry pi, Camera interfacing, GPS module, face detection, server etc

1. INTRODUCTION

Now a days the surveillance in military areas is required but the quality of that surveillance is not up to the level of expectation. This is resulting in the increasing ratio of lives of the soldier in danger. So as to improve the quality of surveillance their should be system which is able to mobile anywhere with effective surveillance. The surveillance can be made effective with the help of high quality video transmission. The quality of video is improvised in the proposed system. The ground bot is able to move on the various surfaces such as muddy areas, staircases, heels. The past few years has seen a lot of technical advancements in surveillance, by the introduction of types of Closed Circuit Cameras. These have assisted in solving crime scenes and yet, the crime rate has not reduced because of the immobility of the surveillance equipments. In any given hostage situations security cameras are the first to be targeted by the felons to protect their identity. So the need for the development of mobile surveillance equipments is at stake. This paper deals in the development of a mobile robot capable of capturing real-time images and videos for surveillance. As by its name, Snitch is capable of going beyond enemy lines to know their secrets and identities for added tactical advantage for its user. Mobility is a major factor of Snitch, and it has to surpass the current hurdles in the field of mobile robotics. There was a boom in development of mobile robots and their capabilities in doing house-hold works like vacuum cleaning to military applications like disarming explosives. BigDog robot [7], AIBO ERS-7 [5] [6], RoboSapien [1] are some of the mobile robots developed in the last decade that are capable of doing a specific task, but most of these robots are capable of functioning only in a controlled environment and are confined only to the horizontal surface. But few robots are capable of climbing on to the vertical surface like Caterpillar Robot [2], City-Climber [3], Gecko Inspired Surface Climbing Robots [4]. They use Bernoulli Effect [16], Tracked Wheel Mechanism, Electrically Controllable Adhesion technology, Electrostatic Adhesion Force [17], Aerodynamic Attraction and Vacuum suction [10] to achieve desired adhesive force to climb on vertical surfaces. But most of them lack the ability to transit from one dimension to the other without any human effort. The robot described in this paper is capable of moving on both horizontal and vertical surface with ease and transit between two surfaces automatically without the need of human help to achieve hassle free mobility while performing the tasks at hand. The City-
Climber [3] is one of the few wall climbing robots which are capable of automatic transition between surfaces, but it uses a vacuum motor to create Aerodynamic attraction to climb on walls. This produces unwanted noise, which can alert the robot's presence. But surveillance equipments should be more discreet or it will give away its position to anyone. This functionality is possible with the unique design of Snitch, which uses the Micro suction Cups [10] providing required adhesive force to be able to stick to the surface and also be removed with ease. So the robot produces less noise and leaves almost no trace.

II. LITERATURE REVIEW

R. Karthikeyan, S. Karthik, Prasanna Vishal, S. Vignesh [1] This Paper draws a novel robot named snitch capable of climbing wall using Micro suction Cups, it makes use of raspberry pi processor is used to manage the robot by a Wi-Fi network for a uninterrupted data processing and conveyance. This robot is suitable for military applications like tracking a person or place of interest, provide skillful advantage in hostile grounds or during unwanted situations.

KunWang, Zhiqiang Wang and Houxiang Zhang [2] It investigates the locomotion mechanism and crawling gait of our flexible wall-climbing caterpillar robot. The concept of a flexible wall-climbing caterpillar robot is inspired by the genetics of the consistent caterpillar. Two kinds of modules, which are connecting module and joint module, were developed. Due to the predefined constraints between the inhalation cups and wall, the motion of the caterpillar robot engages a changing genetic set which is from an open group to a closed group, and then to an open group orderly.

Elliott, M., Morris, W., Jizhong Xiao [3] The modular design obtains both fast motion of each module on unvarying surfaces and smooth progress between the available surfaces. The video also displays the eloquent simulation results of the aerodynamic tendency with the aim to optimize the design. DSP-based control system is intro-Surveillance Robot Using Raspberry-Pi Technology which enables the robot to operate both manually and autonomously.

Tushar Maheshwari, Upendra Kumar, Chaitanya Nagpae, Chandrakant Ojha and V. K. Mitta [4] Wireless operated spy-robots can be truly useful if they can be controlled remotely over a long distance operating ranges. Availability of multiple procedures for their wireless control operation can further improvised their capabilities and the range of applications. In this paper we enroot a prototype watcher that can be controlled remotely, using multiple modern techniques. The spy-robot can be inhabited using a smart phone based DTMF, distantly control application, audio commands and frequently changing gesture control function. DTMF uses the alpha-numeric keypad of the mobile phone. The remote control function is developed for the Android platform based smart phone.

Rui Chen, Rong Liu, Jifan Chen and Jin Zhang [5] In this paper, the design, analysis and forgery of a quadruped wall-climbing robot is given. Inspired by the climbing bearing of geckos, the robot has genetics similar to a gecko’s motion. Unlike geckos stick on the wall surface with force, the robot is based on electrostatic adhesion force induced by a specially designed electrostatic adhesive footpad. By combining the bionic bearing design of the gecko and the unique assets of electrostatic adhesion mechanism, the robot has profit of light weight, low power consumption, flexible movement and high versatility to different wall surfaces. Climbing practice on the surface of a high-rise glass window are exhibited, and the robot can achieve straight climbing and turning robustly and agilely.

Deepika R, Prathyusha K, Amulya P [6] This paper presents the framework on vision based interface that has been designed to instruct a humanistic robot through gestures using image processing. Image predefining and blob detection techniques were used to obtain sign language. Then we evaluating the images to recognize the gesture given by the user in front of a web camera and take an relevant movements (like taking picture, moving robot, etc). The application is developed using Open CV (Open Computer eyesight) libraries and Microsoft Visual C++. The movements obtained by processing the live images are used to command a humanistic robot with simple
capabilities. A commercial robotic human toy robot Robosapien was used as the o/p module of the system. The robot was consolidate to computer by USB-UIRT (Universal Infrared Receiver and Transmitter) module.

Osumi H, Yokohama K, Takeuchi K, Nakamura R [7] In this paper, first a method of using force redundancy of the robot is proposed for speeding Surveillance Robot Using Raspberry-Pi Technology Synopsis up of collateral legs with the constraints due to ZMP, the capability limits of connecting actuators and the limits of available friction forces. Then, an algorithm for retrieving the fastest walking pattern in a trot gait specific time span is developed by combining the result of the collateral legs and that of the waving legs. The obtained walking stensils is installed in a quadruped robot SONY ERS-7 and its performance is varied by experiments.

S.Wu, M. Li, S. Xiao [8] The paper proposes a wireless dispersed wall climbing robotic system for exploration purpose. Firstly, we introduce the work of the distributed wall climbing electronic system. The mother wall-climbing robot of one single inhalation cup with two wheels loco-motion system enables fast motion and can accommodate nearly any kind of vertical wall surface in non-rural environment. The child wall climbing robot is an inchworm-like civilized mechanical structure with the advantages of compact size and light weight, which enables the robot turn from one surface to another and can avoid exposure. Secondly, embedded bureaucrat of wall climbing robotic system are designed. With the Li-battery energy supply and wireless transmission system, robots have the caliber to explore the world semi-autonomously.

AkioY, Takumi N, Toshiro H [9] Electrostatic adhesion is evaluated for robotic wall climbing. To recognize electrostatic wall adhesion, adjustable electrodes were fabricated using plastic film and conductive foil. The wall grip performances were measured for conductive and non-conductive areas. The measurement results for a consecutive surface revealed that, adjustable electrodes can work as a suction cup, and that both air suction force and electrostatic force can subsidize to wall adhesion. A prototype robot using the adjustable electrodes was formulated, which could successfully climb up on a conductive wall with 6.6 mm/s.

M Fujita [10] In this paper we describe effects of human interventions with a pet-type robot, especially with AIBO. First, we portray a design concept for AIBO based on how to improve its "natural" appearance. By introducing statistical results of marketing, and practice involving human-robot interactions using AIBO, we show that this pet-type robot activates human feelings adequately. Furthermore, the experiments validates that AIBO helps in human-human communication. We discuss the anomaly of interaction with AIBO, and attempt to explain why this happened.

III. MATHEMATICAL MODEL

A mathematical model is a statement of a system using mathematical concepts and language. A model may help to elaborate a system and to study effectives of different ingredient of a system to predict the behaviour of system. The Mathematical model for our system is as follows:

\[ T_{m} + T_{e} = T_{m} + T_{e1} + T_{e2} + T_{e3} + T_{l} \]  \hspace{1cm} (Equation[1])
\[ L_{m} * F_{m} + L_{e} * F_{e} = L_{m} * F_{m} + L_{e1} * F_{e1} + L_{e2} * F_{e2} + F_{e3} + L_{l} * F_{l} \]  \hspace{1cm} (Equation[2])

m = motor/motor supply
e = electronic supply
T1 = sensors
l = loss
Tm = Fm * Lm = Tm * Wm

Equation [1] :- This equation states that the power drawn from the power source must equal the power use by each block plus some loss.
Equation [2] shows the same relationship, but it is broken down into voltage and current.
Equation [3] shows the relationship between the voltage and current in the motor vs. the motor torque and angular velocity.

Mathematical Model for Face recognition:
- **Input:** Captured Image.
- **Output:** Recognized Image/Detection of Attacker.

Capture image and send File to system

Let $S_1$ be a set of parameters for Selecting File $S_1 = (\text{Img\_Size} , \text{Img\_Upload})$

<table>
<thead>
<tr>
<th>Image Size = Actual size of file</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Type = Type of File</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condition/Parameter</th>
<th>Operation/Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Image Type==Allowed</td>
<td>f1:Proceed()</td>
</tr>
<tr>
<td>Else …</td>
<td>Discard Operation</td>
</tr>
</tbody>
</table>

If image type is valid then proceed Else discard operation.

Venn diagram:

Let $M$ be the Mathematical Model which Consists of User set, Server And Destination Set $M=0 (U, S, D);$

- $U = (U_1, U_2, \ldots , U_n)$ ||Set of users
- $S$ - Server
- $D$- $(D_1, D_2, D_3, \ldots , D_n)$ ||Destination

IV. CONCLUSION

In this paper a variety of surveillance technique are discussed which consist of development of different robots using the raspberry-pi technology. For each of the robot detailed discussion consist of the working of the approaches which are used to fulfill requirements of the surveillance. This also includes the the advantages and shortcomings of all developed robots. Some of the techniques work only for small areas or for some specific environmental conditions which overcome by the other robots. When we come across the proposed system the system includes the feature of the face detection which results in the implementation of the feature that is intrusion detection. The face detection algorithm works for the identification of the face that is friendly person & enemy. But this work with maximum accuracy of matching 70% of face. Overall study tells that all approaches trying to provide better result in terms of quality of the video transmission and also trying to improve the efficiency in terms of time taken by face detection algorithm & video transmission.
REFERENCES


