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A Survey on Robotic applications in Surveillance and Rescue-Aid

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Abstract: ***Whilst a natural catastrophe like an earthquake hits a populated place, rescue groups should get a quick review of the scenario that allows you to identify feasible places of sufferers, which want to be rescued, and threatening locations, which want to be secured. With a view to offer the rescue facility, superior robots embedded with sensors are in top awareness of attention. Many structures of robots have been proposed and implemented in the literature. This paper provides a review of the various robots used for surveillance and disaster rescue aid. The paper discusses the unique features, pros and cons of each implementation. The key gaps and future directions are discussed.***
Keywords: Robots, Surveillance, Rescue aid, Disaster-Management, Snakebot.

I. INTRODUCTION

Over the last few years, many people have lost their lives because of earthquakes [1] and finding the survivors and evacuating them could be a tedious mission as human intervention is constrained in a certain disaster prone areas and lack of equipment pose a vital hurdle. As soon as a natural catastrophe like earthquake hits a geographical vicinity or accidents like gas leakage,blasts etc.., takes place in a building, rescue teams have to get a fast yet precise of knowledge of the location of victims and threatening locations to be secured. The chances of the victims surviving after a disaster exponentially reduces with passing time. Hence quick action is needed. In this direction, robots have proven to be a great aid to the rescue missions [2]. The rescue missions dictate speedy response, accuracy in assessment and quick and efficient measures. This requires that the first hand information provided regarding the disaster site is correct and reliable.

Today, rescue teams get in catastrophe zones even as not knowing what lies beforehand. This conjointly places their lives in danger [3]. The maximum essential undertaking that rescue teams face is the accessibility. A catastrophe- hit area is usually very difficult to enter or access. Hence acquiring necessary data about the site of disaster and status of victims or survivors is an even bigger challenge. Thereis a high demand on the tolerance and abilities of the robots deployed at disaster sites because They will have to truly task into unknown and risky territory humans probably cannot. Hence robots with an ability to be able to fit into narrow openings, withstand the unfavourable conditions at the disaster sites, move freely across the uneven and rugged pathways are needed. Superior robots embedded with sensors and diverse features are the centre of attention of researchers for disaster control and rescue aid.

II. LITERATURE REVIEW

Regardless of superior technology, rescue operations in the course of a disaster are often slow in mass panic. The reasons can be narrow inaccessible spaces, uneven terrain surfaces and debris.

Catastrophe surveillance advancements in the form of a marsupial group [4]. The robot consists of a large robot(referred to as mom)and one or extra smaller robots (further referred to as micro rovers) for the mission. The mom is equipped with electricity wheels chassis, an on board pc is attached and a radio ethernet hyperlink, GPS, six sonars for navigation, inclinometers, and a panning sensor pod including two cameras plus a thermal sensor for detecting survivors. The authors have delivered a microphone for hearing the survivors and a video transmitter to ship snap shots directly to the resuce team.The mom can also bring a payload of batteries. The micro rover can get this additional power supply via a tether. The batteries are retained close to the deployed micro rovers; this keeps the tether from going askew when it rubs against sharp objects [4]. As a substitute in [5],a tetherless micro rover can range for longer durations of time compared to [4]. Micro rover may attempt to reach the deepest indoors due to the fact this is wherein survivors are anticipated to be. It is a semantic seek. While she (the mother) travels, she uses sensor fusion to discover a survivor, based totally on affordances (the possibilities that the surroundings offers the robot) inclusive of imaginative and prescient cues, sound and heat. This opportunistic search is incomplete due to the fact the robot is processing sensor statistics accumulated as a derivative of navigation in place of from an energetic seek [5].

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To address the disaster surveillance, a particularly mobile, lightweight to control robotic was created in [6]. The machine is designed from the ground up with precise functions to fight the irregular terrain found in an urban search and rescue surroundings. Especially, the robot was designed to overcome 3 particular limitations that represent a pattern of the kinds of impediments observed in a collapsed construction: non-cohesive abnormal terrain (which includes piles of unfastened rubble), an open canyon or deep void, and a ladder or open stair. However the lack of authentic tracks plus the lack of adjustable compliance resulted in many conditions in which the simulated robot could be stuck because it traversed choppy uneven terrains. a pointy fringe of an obstacle could get wedged in-between the wheels, stopping any rolling motion without lifting that automobile off the obstacle. The chassis designed is lightweight, long lasting and practical. The open shape ensures easy access to any parts which need to get replaced or repaired. Waterproof overlaying methods are to be brought in the mere future to shield the additives from capacity damage because of environmental factors at some point of catastrophe relief conditions.

Authors in [7] suggest a design of a robot to move slowly and slither without the use of wheels or legs. Friction between the snake's structure and the environment is encompassed by means of its design. The gait of the snake is enabled by means of inducing a sinusoidal rhythm to the segments.

Wheel-based robots have several limitations -they cannot climb, cannot stroll over rough surface, difficult to stroll over terrains. So, engineers have worked in this course and designed serpentine robots [8] that may climb, can crawl over difficult surfaces.In this paper researchers explained the biological structure of snakes and the research model also explained locomotion and its logistics.

Hirose et. Al.,[9] developed the arena's first snake robot as early as 1972. Hirose studied biological snakes which helped in growing a model of the snake body that might move ahead and not move sideways.

A PIR is utilized which emits infrared rays to detect live human beings, as live humans emit thermal radiation. In this rescue team, a floor rescue robotic functions as the primary commander, an aerial rescue robot is used for correct identification and air guide. The rotation of the geared dc motor for maximum torque and minimum velocity and motor derives with relays for turning and motion in ahead and reverse guidelines with accuracy. [10]

The detection of survivors using Pyro Metric Sensor (PIR) with automated alarm and with the capability to call the rescue team for the emergency assist is discussed in [11]. A PIR is utilized inside the assignment which emits infrared rays so to detect live human beings aslive humans (frame) emit thermal radiation. In this rescue group, a floor rescue robot features as the main commander; an aerial rescue robot is used for greater accurate identity and air support. The rotation of the geared dc motor for max torque and minimal speed and motor derives with relays for turning and motion in ahead and opposite instructions with accuracy.

Wheel-based robots cannot climb, cannot stroll over choppy floor, hard to move over terrains. So, engineers have worked in this route and designed serpentine robots which could climb, can slither slowly over hard surfaces. In this paper researchers explained the structure of snakes and the studies performed in this course moreover defined its locomotion kind [12]. The researchers analysed the adoptability of snake robots in seek & rescue operations and the way those robots can reach vicinity like narrow cracks, tough terrains and excessive environments wherein exceptional seek mechanisms or human beings can't reach. But snake robots have low power and performance. However the researchers end that, this innovation can overcome the boundaries and snake robots can be a totally successful mechanism.

A further enhancement performed in the field of surveillance is a robot that is capable to rotate 360 degree without any displacement. An appropriate length × width × height for frame of any such robotic could be 18″ × 12″ × 3″[10]. The sensors are interfaced through Arduino Uno board. The robot is geared up with LPG gas sensor, Temperature and Humidity mild sensor, Magnetic discipline sensor, Steel detector. It has a digicam that is equipped with two way audio verbal exchange, day and night imaginative and prescient. Digital camera affords live streaming. Transmitter circuit of robot is largely remote of the robot which is operated by the rescue person. The RFremote of robot includes two RF transmitters which transmit signal with the use of two antennas. The user also can use any android primarily based tool as far away to control the robot., here the robot uses Bluetooth link.

But the robot is bound to certain limitations like poor power efficiency and lesser control, due to the comparatively wide body of the robot. [13]

Nowadays, rescue groups enter disaster affected zones without understanding what lies ahead. This additionally places their lives at risk [2]. Recon rover [14] created using NI's labview platform, cannot only solve this hassle but also can lessen manpower cost. To deal with this trouble, a recon rover is created, with a quite-advanced consumer interface which can be managed very easily. NI supplied us to get entry to numerous equipment required to make this product bendy and scalable. Few years after the rover invention, every other snake robot is used within the Mexico earthquake as a real disaster surveillance resource. The problem faced during the usage of the robot was lack of microphones and speaker as they were of prime requirement by CMU's snake robotic crew while attempting to find Mexican earthquake survivors.

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Ainapurapu [15] explains about GPS co-ordinates for locating the robot. Potential packages of this research are low price and provide durable surveillance.

Currently, the subject is a topic of extensive research amongst renowned institutions like NASA, MIT USA and Carnegie Mellon University. Snakebots are currently being researched by NASA for exploring Mars.

III. DISCUSSION

Surveillance is an application that is continuously being updated. Use of robots for surveillance is synonymous with efficient tracking and assessment of disaster sites. The structure of robots has been widely researched and experimented with. Studies on snakebots has increased in the past ten years, but there are still many demanding situations to face at the modelling, control and communication problems of snake robots, to make them capable to locomote intelligently through terrain surfaces and talk better with the rescue crew through continuous data right now for immediate movements to be taken by way of the rescue teams to save innumerable lives in much less time. Live video streaming, object detection for information acquirement, are the prime subjects for further research on snakebots. The mechanical shape of the snake is another prime criterion to be paid interest about. The disaster region could be uneven and slender for any robot surveillance, so the robot shape is to be made as minimal as viable for higher surveillance.

TABLE I Liteature Survevy Table of the prevailing Surveillance Robots.

Title	Surveillance	Sensors	Mechanical design	Remarks
Marsupial and shape-shifting robots for urban search and rescue	Radio ethernet hyperlink, GPS, six sonars for navigation	Thermal sensor and Inclinometer	Two robots using master slave mechanism.	PIR sensor for human live detection is provided.
Design of a low-cost, highly mobile urban search and rescue robot. *Advanced Robotics*	To overcome non-cohesive abnormal terrain, An open canyon or deep void, and a ladder or open stair.	Basic sensors embedded.	Open shape lets in easy get entry to any parts which can need to get replaced.	No PIR, temperature sensors embedded.
Design and control of a snake robot according to snake anatomy.	Deisgned according to snake model	Basic sensors embedded.	Robot without legs or wheels	Slender structure and flexible. Power consumption Live video streaming
Live human detection robot.	Floor and Air surveillance with accurate forward and backward motion.	PIR sensor and temperature sensor	Floor rescue robot and air rescue robot	Air rescue robot and presence of other advance sensor
Snake Robot Urban Search After the 2017 Mexico City Earthquake.	Earthquake live survillance	Camera module. No gas sensors.	Slender body to enter narrow places.	Live streaming camera module. No object detection and lack of microphone and speaker.
Wireless Operating Robot for Disaster Management	Live video with day and night vision. Two way audio communication	LPG gas module, Temperature and humidity sensor light sensor, Magnetic field sensor, Metal detector.	Comparatively wider body structure without an outer protective shell.	Live video streaming with speaker module. Mechanical structure and lack of PIR, Gyroscope and other hazardous gadetecting sensor.

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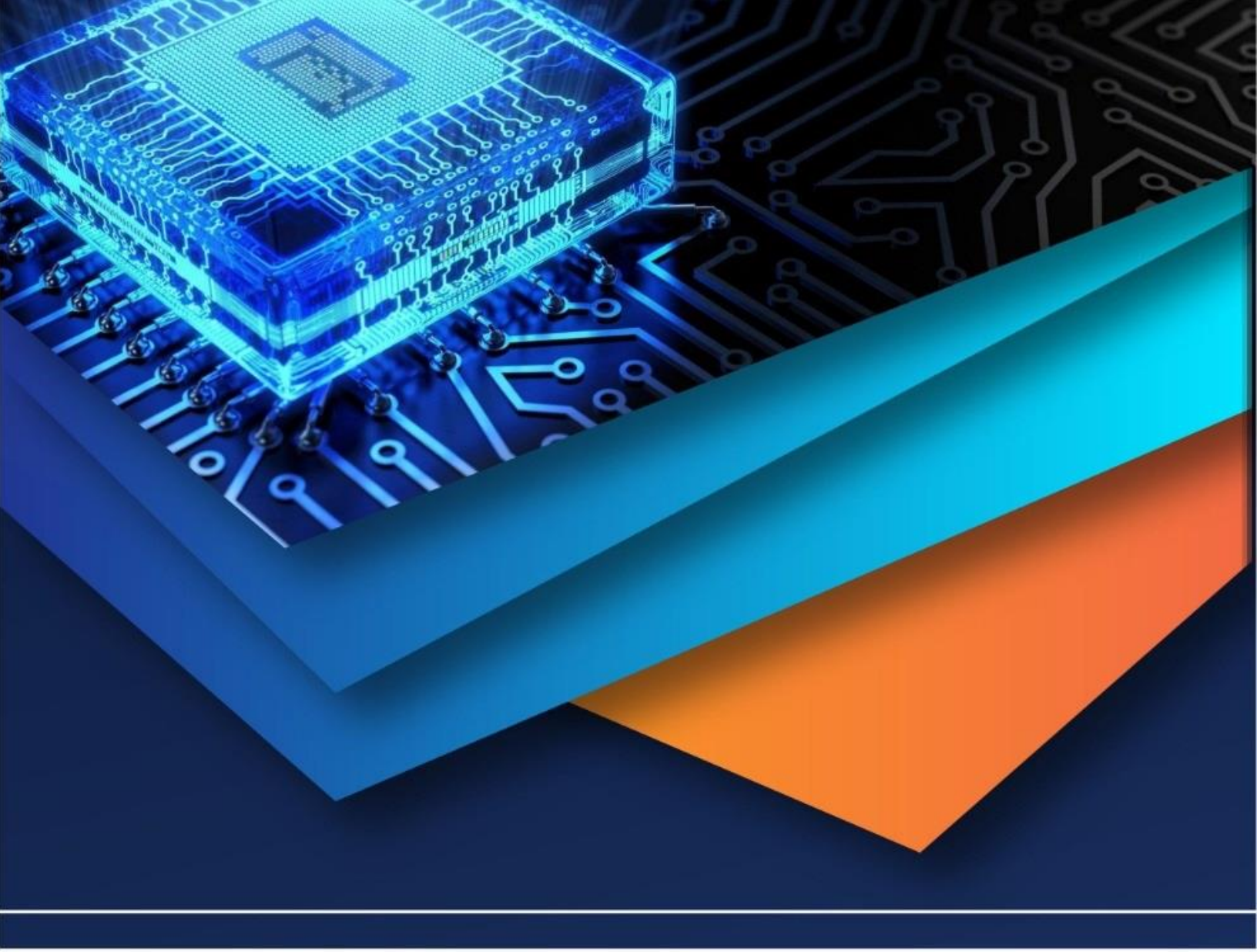
IV. CONCLUSION

The paper discusses various robotic structures. The applications and scope of surveillance robots have been discussed. Robotic structures with wheels have the advantage of simplicity but they cannot move efficiently in rugged or uneven terrains The snakebot has bad energy efficiency and an excessive variety of tiers of freedom. Nonetheless, the snake robot reveals first rate terrain capability and has the functionality of examining narrow places. It could additionally be made very sturdy to dirt via masking the robotic completely with a shell and making the additives water-resistant. A simple prototype changed into evolved to illustrate the capacity to implement these mechanisms in actual, low-cost and effortlessly repairable unit. A bodily simulation became advanced to assist with the design of user interfaces for simple control. Those properties of flexibility make the research and real-time application of snakebots worth-while. It is hoped that this survey record will help promote further research at the fascinating subject matter of snakebots via the overview given on modelling and locomotion.

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