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ESP32-Enabled Iot Robots Solutions For Enhancing Hospital Security

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ABSTRACT

Create an interactive robot to assist with hospital security and online monitoring. The robot should improve patient experiences by offering services such as bomb squad, gas and fire safety, and live surveillance streaming while also delivering pertinent information. The main objective of this project is to create a robot that can observe human activity in hospital locations. Minimizing hostile invasions and hazards to human life is the goal. With its wireless camera, the robot can send live video footage from the field. By cutting down on fatalities and stopping illegal activity, this gadget will be of immeasurable use to the Defense Hospital. A camera is mounted on the robot to improve visual clarity of its surroundings, and robotic actions can be monitored and controlled via a wireless network using an IOT app. When the amount of smoke in the air rises, the smoke detector signals a possible fire. Since most bombs have a certain quantity of metallic materials, we are using a metal sensor in this instance to identify the presence of an explosive device. The Bluetooth app may be used to control this mobile robot, and the app receives updates from the sensors. Images and videos are taken by the camera and sent to the receiving station. The flame sensor provides information to the base station after detecting the presence of a fire. While the gas sensor finds potentially dangerous gasses in the surrounding air and can sound an alarm if necessary, the metal detector can locate metallic items and hidden bombs. In the near future as well as the present, these robots will be extremely valuable.

Keywords: IoT Robot, Hospital Security, Patient Safety, Smart Healthcare Solutions, AI-Enabled Security

1. INTRODUCTION

Using Internet of Things technology, this project describes a network of real-world items that have sensors and software implanted in them to exchange data online. The idea suggests an Arduino-controlled spy robot as a comprehensive solution, focusing on tackling security issues and the possibility of terrorist actions at borders. The robot's goal is to reduce dangers to personnel and improve military surveillance capabilities by using an IoT cloud platform.The main protocol allows for remote control and real-time data sharing by enabling the robot to be operated via an IoT cloud platform. The technology that uses a camera module for live streaming and direction control to identify unauthorized persons was developed due to security and army personnel safety concerns. Furthermore, a metal detector is incorporated to identify explosives and mines, and it triggers GPS upon detection to notify users and pinpoint the threat's location. Thanks to its multifunctional design that allows for remote identification of illegal individuals, the robot is positioned as a stable and secure espionage tool for use in combat situations. Historically, improving operational capabilities and guaranteeing personnel safety have been greatly aided by the incorporation of technology into military applications. The use of Arduino technology as an adaptable single-board computer in the production of military robots has become more popular. These reconnaissance robots are highly useful for identifying potential dangers, obtaining information, and functioning independently in difficult situations. They come equipped with

sophisticated features including a metal detector, gas sensor, and night vision camera. To travel independently, recognize targets, and avoid obstacles, the robots use a variety of sensors, including as accelerometers, GPS, LIDAR, cameras, and infrared sensors. Arduino is used to enable communication, which guarantees smooth connection with command centers, distant operators, and other robots. To improve situational awareness, safety, and operational efficacy, metal detectors warn operators of buried explosive devices, gas sensors track the quality of the air, and fire sensors identify flames.An example of cutting-edge technology intended for effective and safe monitoring of conflict zones is the spy robot. The robot may be tailored to match the unique requirements of various military missions and is capable of gathering information in real-time. Its main goal is to cover battle zones visually by filming in real time and sending the recordings to distant locations over a wireless network. As a result, military people can decide with knowledge without running the risk of injury. The project's goal is to create an Arduino-controlled espionage robot that can operate wirelessly via an Android application, in recognition of the difficulties that the armed forces encounter even with high-quality technology. The robot should have 360-degree mobility, a wireless camera that can transmit video in real-time, and dependable, secure wireless connectivity. Soldiers can easily watch human activity in conflict zones and identify potential dangers thanks to the robot's easy-to-use Android application. In addition to metal detectors, nocturnal and night vision cameras also help with increased security and intelligence collection. The robot may be controlled remotely through phone calls, making it a flexible instrument for monitoring, identifying hazardous weaponry in difficult-to-reach areas, and detecting obstacles.In order to substitute human labor and get around constraints, this article investigates the use of robots in monitoring operations in conflict zones and inaccessible places. In addition to border risks in areas like Kashmir and Ladakh and terrorism threats in cities like Mumbai, the Indian government must make large investments in its military and security forces. Because it puts people in danger to investigate these places following catastrophic events, cutting edge technology are essential. Recently, the Daksh military robot has been used in conflict areas by the military. Robots' capacity to conduct constant surveillance while getting over human presence restrictions is a major benefit of using them in these kinds of situations. In order to overcome the issue of a restricted frequency range, the Internet of Things (IoT) is also included, enabling remote control and information reception for the robot. The robot is equipped with ultrasonic sensors to identify impediments and may change course automatically in an autonomous mode. The robot has a live streaming camera attached to it, which improves the sensor underlying it's sense of touch. In addition, GPS is used to send the robot's exact location. With the help of this creative strategy, vital locations are monitored in real time, reducing the risk to people and offering useful data for security and military activities. The effective surveillance and intervention in areas of strategic importance and possible threats is enhanced by the application of modern robots and IoT technology.

2. LITERATURE REVIEW

Researchers A. K. Singh, A. R. Singh, and S. Kumar (2017) "Unmanned aerial vehicles (UAVs): A review on military applications," Global Conference on Computers, Communication, and Automation (ICCCA) 2017, held in Greater Noida, India Under the acronym UAV, which stands for Unmanned Aerial Vehicle, an aircraft without a pilot is typically thought of as a drone. UAVs are capable of being piloted by remote control. Cameras, sensors, communication equipment, and other payload devices are all included in the unmanned aerial vehicle. To safeguard the border, it was designed for both military and civilian use. Military applications for UAVs are extensive. Starting in 2005, the US Department of Defense (DOD) began building unmanned aircraft systems. Nowadays, the United States, Israel, China, Iran, and Russia are the top producers of UAVs. India is developing the Rustom class of unmanned aerial vehicles. A UAV can be built more affordably, with less complexity and at a lower cost. The components of a UAV are necessary.

2020; J. A. G. P. Ferreira, A. C. R. da Silva, and P. M. C. G. Rodrigues: "Robotic systems for surveillance in military applications: A review," 2020, 15th Iberian Conference on Information Systems and Technologies (CISTI), Seville, SpainA safe and effective method of keeping an eye on combat zones is provided by the sophisticated technology used in the spy robot. Not only can it be tailored to match the unique requirements of various military missions, but it can also gather information in real-time that can be used to make informed judgments. By capturing live videos that can be transmitted to distant locations over a wireless network, the robot's main objective is to offer visual coverage of combat zones. This preserves their safety while enabling military personnel to assess the situation and make judgments. Automation and robotics have seen significant changes as a result of new technologies, particularly in the defense and home sectors.

Joshi, Deepali V. Mahajan (2014): "Arm 7 Model Based Vehicle Positioning, Theft Prevention, and Accident Identification." ISSN: 2278-3075; Volume: II, Issue 2, July 2014; International Journal of Innovative Technology and Exploring Engineering (IJITEE).As the world's population grows, so does the crime rate in the automotive industry. Technology is not keeping up to prevent vehicle theft or to identify instances in which a vehicle has been stolen or moved without the owner's knowledge. This is resulting in a decrease in the medical team's help at the accident scene, a rise in other connected problems, and poor accident sense system performance. This article describes the design and execution of a wireless network communications-based car theft and accident detection system that uses GPS, GSM, and Arduino. When an accident or reckless driving occurs, the system notifies the owner and any surrounding rescue teams. It also notifies the owner in the event that the vehicle is stolen or that its position is altered without the owner's knowledge. Search and rescue teams are notified of the location. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 4, April 2014, Mr. S. Iyyappan, Mr. V. Nanda Gopal, "Automatic Accident Detection and Ambulance Rescue with Intelligent Traffic Light System." Using ITLS to mechanically control the traffic lights in the ambulance's path is the concept behind this plan. In order to ensure that the ambulance arrives at the hospital safely, the control unit that operates the ambulance provides a suitable route and manages traffic lights based on the ambulance's location. The controller finds the accident site by using the sensor systems in the car that detected the collision, and then it navigates through the ambulance to get there. The totally automated nature of this approach enables it to locate the scene of the accident, manage traffic signals, and facilitate timely arrival at the hospital.

MONTASER "Intelligent Anti-Theft and Tracking System for Automobiles," International Journal of Machine Learning and Computing, Vol. 2, No. 1, February 2013, N. Ramadan, Sharaf A. Al-Kheder, and Mohammed A. Al Khedhe, 2013: Senior Member, IACSIT". With an embedded system equipped

with a Global Positioning System (GPS) and a Global System of Mobile (GSM), an effective anti-theft automobile security system is put into place.The vehicle's current location and state are determined by the client using Google Earth and vehicle interaction through this system. GoogleEarth allows the user to track the location of certain automobiles. A GPS locator is used to detect the target's current location, which is then relayed by Short Message Service (SMS) across GSM networks to a GSM modem attached to a PC or laptop, along with other characteristics received by the vehicle's data port.Discrete Kalman filter is utilized to rectify the GPS coordinates.

An inexpensive surveillance robot that uses an Arduino microcontroller, a motor shield, and an Android smartphone running the operating system is being developed by J. Azeta, C.A. Bolu, D. Hinvi, A.A. Abioye, H. Boyo, P. Anakhu, and Ponwordi in 2019's Procedia Manufacturing, IEEE 2019. A video camera and a wifi robot link make up the robot. Excellent hardware that meets the aforementioned requirements is a feature of smartphones. Application Programming Interfaces (APIs) that come with the operating system can be used to take advantage of this. The robot using a smartphone, however, has a substantially lower construction cost. With its integrated smart phone interface, microcontroller, and wifi module, the robot can be operated from a distance.

Automated Visual Surveillance in Realistic Scenarios is the topic of Mubarak Shah, Omar Javed, and Khurram Shafique's 2019 IEEE paper.In the context of surveillance and intelligence, identifying the location of an image and geolocating structures that are portrayed are crucial jobs. The picture could depict, for instance, a safe house's surrounds or terrorist training grounds. Because geo-localization requires the user to combine prior knowledge of the area with minor hints from the image, it reduces the need for the laborious manual search of GIS reference data.

Snatching Upendra Kumar, Deepika R, Chaitanya Nagpae, Chandrakant Ojha4, and V. K. Mitta's Spy-Video Data Capture Using a Flexi Controlled Spy-Robot, IEEE 2015. The wireless control operation of these devices can be further improved and their range of applications expanded by having several modalities available. We create a remote-control prototype spy robot in this work that can be operated in various ways. An application for voice commands, tilt-gesture control, remote control, and DTMF based on a smartphone can be used to operate the spy robot. Alpha-numeric keypad on a mobile phone is used for DTMF.

In the April 2014 issue of the International Journal of Scientific and Research Publications (IJSRP), K. Shantanu and S. Dhayagonde wrote, "Design and Implementation of E-Surveillance Robot for Video Monitoring and Living Body Detection."In hostile territory, security personnel are policing the border. Security cameras that have previously been installed are helping them, but they only cover a very small area. Since we cannot instantly alter the camera perspective, the cameras that are currently set in place are not very useful. Mounting cameras in forested locations is also not feasible due to tree obstructions that impede the camera's view. The design and implementation of a wireless robot that can be controlled over the internet is explained in this study.

"Mobile Robot Surveillance System with GPS tracking" was developed by Harindravel and Letchumanan.2013.Both moving along a predetermined path and in accordance with the line that determines its route can be accomplished by the robot. The Global Positioning System (GPS) tracking application, a significant component of the project in addition to the robot, is regarded as highly important.

Siva Sankari SA and Pavithra S, "7TH sense-a multipurpose robot for military," IEEE International Conference on Information Communication and Embedded Systems (ICICES), (2013), The military forces of the globe are paying close attention to what Patton has to say, given the high potential for conflict in the world. The foot warriors have been the winners of battles since the beginning of time. The role of the infantry has evolved during the last ten or so years, though, as a result of the development

of smart weapons and precision aerial bombardment, forcing infantrymen to engage in difficult urban fighting in order to wipe out any last pockets of opponents. The valiant warrior of the future will not charge into combat. The equipment used by infantry soldiers is being updated by our system, which is the first of numerous similar projects.

"Internet of Things in industries: A survey," published in IEEE Transactions on Industrial Informatics, by Da X, Li WH, and Shancang L (2015)The burgeoning prevalence of radio-frequency identification (RFID), as well as wireless, mobile, and sensor devices, has made it possible to leverage the Internet of Things (IoT) to create robust industrial systems and applications. The industrial Internet of things has seen the development and implementation of many different applications recently. This article presents an overview of the state of IoT research, important industrial applications, critical enabling technologies, and research trends and difficulties in an attempt to comprehend the evolution of IoT in industries. This review study makes a significant contribution by providing a systematic summary of the state-of-the-art IoT in industry.

A power autonomous, untethered, compliant-legged hexapod robot named RHex was designed and controlled by Saranli U, Buehler M, and Koditschek DE. Their article appeared in The International Journal of Robotics Research. The mechanical simplicity of RHex—six actuators total, with one motor at each hip—allows for dependable and durable performance in everyday chores. Simple, openloop, clock-driven tripod gait provides the basis for highly maneuverable and empirically stable locomotion. Robotics Research International, Saranli U, Martin B, Daniel EK, "Rhex: A simple and highly mobile hexapod robot," to increase safety as we can use this robot to know what the enemy is up to and maintain a safe distance from them. It also has a laser that locks the enemy's position and guides the missile; it also has a metal detector that helps detect land mines, which can be fatal. We can control this robot easily as it can be controlled wirelessly and by connecting it to any Android mobile device via Bluetooth.

Buehler M. and D. McMordle With a hexapod robot, toward pronking. 2001's International Conference on Climbing and Walking Robots provided a pronking controller for our six-legged robot, RHex. The robot is naturally adapted to running, hence the controller is developed using a passive-dynamics approach. Tracking fixed joint reference trajectories and detecting touchdowns are then accomplished by running with flight phase and solely using proprioceptive (joint angle sensing) feedback. Through an open loop leg speed change during stance, body pitch oscillation is reduced. At 1.85 specific resistance, the robot reaches velocities of roughly two body lengths per second.

Model-based dynamic self-righting maneuvers for a hexapedal robot. Saranli U, Rizzi AA, Koditschek DE. A controller for our hexapedal robot, RHex, that can accomplish dynamic self-righting was designed and analyzed for publication in the International Journal of Robotics Research. Inspired by an empirically adjusted controller's early success, we describe a feedback controller built on the robot's saggital plane model. Furthermore, we expand this controller to create a hybrid pumping method that achieves strong flipping behavior across a variety of surfaces while overcoming actuator torque restrictions.

In the article "Wireless Sensor Networks: a Survey on the State of the Art and the802.15.4 and ZigBee Standards," Paolo Baronti, Prashant Pillai, Vince Chook, Stefano Chessa, Alberto Gotta, and Y. Fun Hu discuss wireless sensor networks.

José A. Gutierrez, Lance Hester, Paul Gorday, Ed Callaway, and Mario Naeve, Venkat Bahl, Bob Heile, "IEEE 802.15.4 Draft Standard and Its Home Networking Applications: A Developing Standard for Low Rate Home Networking." Several home applications that require low-data-rate communications in an ad hoc self-organizing network can benefit from the standard, which has three primary features: cheap cost, low power consumption, and network flexibility.

IEEE 802.15.4: Will it lead to pervasive networking? JianliangZheng, Myung J. Lee IEEE Communications Magazine, June 2004, "A discussion on a potential low power, low bit rate standard. "Device level wireless networking is provided by low rate wireless personal area networks (LR-WPANs). Together with improving already-existing applications, they unveil a plethora of new uses. In applications including inventory tracking, combat field monitoring, public security, and home and office automation, LR-WPANs are perfect because of their low cost, low power consumption, and self-organization features. All the same, before LR-WPANs become widely used, one crucial problem—security—must be resolved. In LR-WPANs, pursuing security is a difficult challenge. Wireless transmissions can be intercepted and interfered with by nature. However, the majority of LR-WPAN devices are under resource limitation and do not have physical security measures in place.

Murray R. M. Science fiction movies and computer-controlled electromechanical devices incorporated into a wide range of industrial environments are examples of how robotic manipulation through mathematics has developed.

In the International Journal of Robotics, Saranli U, Rizzi AA, and Koditschek DE describe "model-based dynamic self-righting maneuvers for a hexapedal robot." Examine how to create and evaluate a controller that will enable our hexapedal robot, RHex, to do dynamic self-righting. Inspired by an empirically adjusted controller's early success, we describe a feedback controller built on the robot's saggital plane model. Furthermore, we expand this controller to create a hybrid pumping method that achieves strong flipping behavior across a variety of surfaces while overcoming actuator torque restrictions. To test the model and assess the new controller's performance, we showcase simulations and experiments.

3. PROPOSED SYSTEM

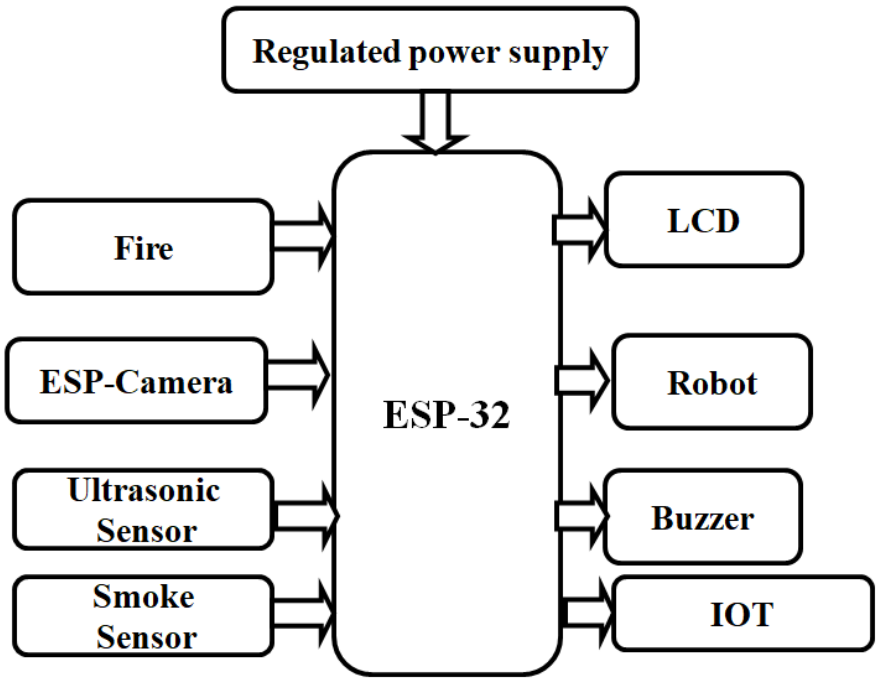

Fig 1: ESP-32

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Technology's quick development has brought about a revolutionary period that is changing not just routine chores but also a wide range of industries, from defense applications to home automation. With their multitude of applications across several operating systems and ability to drastically alter lives, smartphones have become influential change agents in today's globalized world. Among the most important contributions has been made by the open-source Android operating system, which offers a wide range of robotics apps to improve daily life. Bluetooth technology, which is essential for serial communication between cellphones and robots, lies at the heart of this integration. An Android application and a battle field robot can communicate with each other seamlessly thanks to the HC-05 Bluetooth module acting as a conduit. The robot is controlled by an Arduino Uno board and uses two DC motors for smooth motion in conjunction with L293D motor driver integrated circuits and the HC-05 module. With a night vision wireless camera that provides real-time situational monitoring, an extra degree of sophistication is added. It's amazing how cleverly this camera rotates 360 degrees, powered by a motor driven by an Android application, giving it unmatched spying powers. Law enforcement relies heavily on automation and robotics, as seen during the historic Sydney Siege. This historic event featured the unique use of technology to reduce dangers and limit the loss of human life: a robot with an integrated bomb disposal kit and a laser beam light was sent into a dark chamber ahead of military commanders. This operation, which was successfully carried out by the police department in New South Wales, serves as a model for efficient and life-saving police operations. It highlights the revolutionary effect of incorporating the most recent technical developments into dire situations.

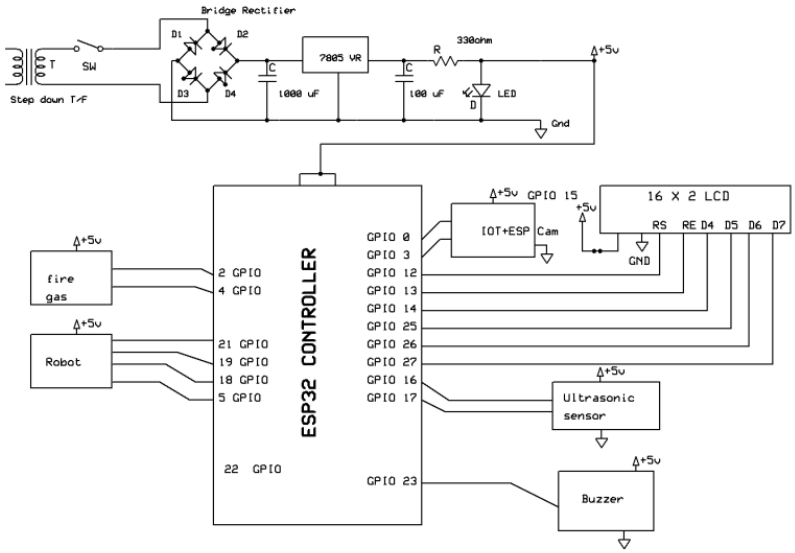

Fig 2: Block diagram

The cblock diagram is centered around an ESP-32 controller, to which several components are connected through its pins. The VIOT+CAM module is linked to pins 0 and 3, enabling contact-based functionalities. A 16x2 LCD display is interfaced using pins 27, 25, 26, 14, 12, and 13 for data and control operations. A GPS module is attached to pin 14, providing real-time location tracking. For robot

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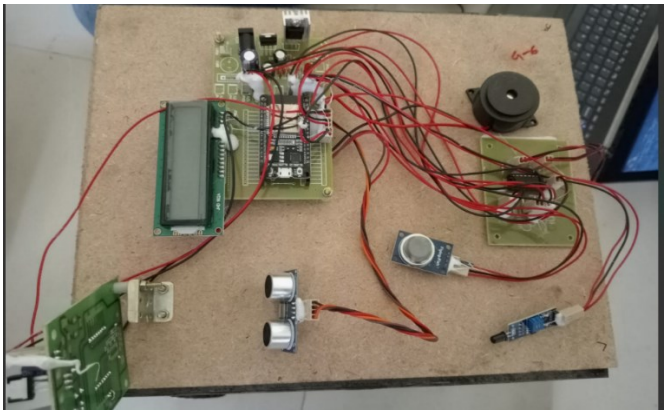
control, pins 5, 21, 19, and 18 are utilized, allowing precise movement and functionality management. A buzzer, connected to pin 23, provides auditory alerts when necessary. The circuit also includes a bridge rectifier and a 12V battery to supply stable power to the system. This setup, through its versatile integration of modules, enables applications in robotics, surveillance, and environmental monitoring.

The implementation of war field spy robots offers numerous benefits for military operations due to their innovative design and specialized capabilities. Firstly, they significantly reduce risk by allowing military personnel to gather critical surveillance footage without direct exposure to danger, minimizing the chances of casualties during reconnaissance missions. These robots excel in stealth operations, moving silently across different terrains without easily being detected, which is crucial for covert intelligence gathering. Equipped with advanced sensors and cameras, they provide real-time surveillance, enabling continuous monitoring of enemy activities and dynamic battlefield assessment. Additionally, their modular design allows for flexibility, letting them be equipped with a range of sensors, cameras, and communication devices based on mission requirements.

Another advantage is their ability to operate 24/7, ensuring uninterrupted monitoring and intelligence collection at any time of day. These robots are remotely operated, allowing military personnel to control them from a safe distance, thus enhancing operational flexibility and safety. Equipped with communication modules, they support real-time data transmission to military command centers, facilitating quick, informed decision-making. By reducing the human footprint in hostile environments, they also aid in maintaining the element of surprise during strategic operations. Spy robots can provide tactical support by identifying enemy positions, surveying threats, and even disrupting enemy communication and supply lines. Furthermore, they offer the possibility to program ethical constraints to minimize civilian casualties and abide by international laws. Economically, they represent a cost-effective alternative to traditional human reconnaissance missions, offering a lower operational cost over time.

4. RESULTS



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5. CONCLUSION

We designed and implemented Hospital Assist Robot for hospital security using security sensor and live video stream camera. The robot should improve patient experiences by offering services such as bomb squad, gas and fire safety, and live surveillance streaming while also delivering pertinent information. The main objective of this project is to create a robot that can observe human activity in hospital locations. Armed with vital intelligence to evaluate and protect regions before to deployment, Hospital personnel can take advantage of real-time video footage from the wireless camera that is controlled via a IoT app. Its ability to detect intruders, possible fire events, explosive devices, and hazardous gasses is improved by the addition of sensors like, smoke, metal, flame, and gas detectors. This robotic system effectively reduces enemy invasions, protects human life, and stops illicit operations in conflict areas by utilizing state-of-the-art technology. Military personnel can operate with greater freedom and safety because to the robot's capacity to be remotely controlled and monitored over a wireless network. Using this robot to conduct reconnaissance and surveillance in dangerous areas is proving to be quite beneficial for the defense Hospital. The significance of robotic systems in guaranteeing the safety and security of military operations is expected to increase with the advancement of technology.

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