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MILITARY SUPPORT AND RESCUE ROBOT

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ABSTRACT

In this era of a politically unstable world, there is a growing demand for the use of military robots to aid the soldiers to perform perilous missions. This paper focuses on the design and build of a semi-autonomous, unmanned robotic system used for various military and rescue operations. Dangerous tasks such as bomb disposal, enemy territory surveillance, search and rescue can be efficiently carried out by the MSRR, Military Support and Rescue Robot. This reduces the risk of losing the lives of both soldiers and civilians. With the help of live feed from the wireless camera and data analysis of environmental composition by various sensors, of the area under surveillance, the soldiers can better prepare for their missions. Using Arduino and Zigbee technology, the above-mentioned tasks can be achieved. The different sensors and the robotic arm are connected to the Arduino mega which in turn is connected to the Zigbee. Data transmission and receiving are through Zigbee technology. This prototype design overcomes the weakness of the existing models and thus provides better support for military operations.

I.INTRODUCTION

In today's technologically proficient world, technology plays an important role in drastically changing warfare tactics. More than advancement in weaponry, the advancement in technology gives a country superiority and the capability to counter an enemy attack in the most effective manner. Nowadays, robots are used in places which are dangerous for humans and thus, carry out the missions more effectively and obediently than human soldiers. The military support and Rescue robot help to locate survivors in hazardous conditions unfavorable to human rescue teams. This reduces casualties and helps plan the rescue more effectively by using the data provided. The utilization of military robots for this very purpose is used by many countries around the world. The robots are robust, daring, obedient and have no fear of death. These robots may not be humanoids and need not carry lethal weapons, they are just machines instilled with advanced technology to aid the military. The many advantages of military robots are driving all militaries around the world to opt for the use of robotic technology. MarketsandMarkets conducted an analysis which concludes that the military robot industry is expected to reach USD 30.83 billion by 2022, at a CAGR of 12.92% from 2017 to 2022 [1]. Military robots can be affected due to

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hardware and software malfunctions. Even though the military robots are built for adverse conditions the robotic system might face challenges due to adverse climate, software malfunction, components breakdown and much more. These types of robots are either fully human controlled, semi-autonomous or fully autonomous. Autonomous robots face more challenge under moral grounds for use in the military. A fully autonomous robot is considered as a killing machine under many country laws. The use of automated machines has a lot of restrictions due to the lack of human feelings and emotions. Hence, it is preferable to use semi-automated robots for certain safety precautions [2]. The MSRR, Military Support and Rescue Robot can be used for many different applications in the military. Among which a few are discussed in this paper, such as Intelligence, Surveillance and Reconnaissance (ISR), Search and Rescue, Mine Clearance and Bomb Disposal.

II.LITERATURE SURVEY

Market, M. (2020). Military Robots Market | Size, Share, and Global Market Forecast to 2022 | MarketsandMarkets™. [online] Marketsandmarkets.com. Online soure available at: https://www.marketsandmarkets.com/Market-Reports/military-robots- market-245516013.html [Accessed 11 Jan. 2020]:

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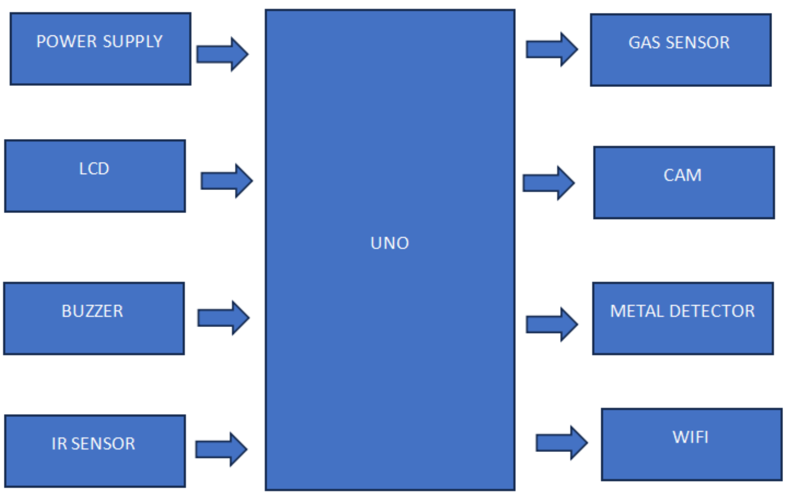
Doroodgar, B., Yugang Liu and Nejat, G. (2014). A Learning-Based Semi-Autonomous Controller for Robotic Exploration of Unknown Disaster Scenes While Searching for Victims. IEEE Transactions on Cybernetics, 44(12), pp.2719-2732.

We present a synchronous robotic testbed called SyROF that allows fast implementation of robotic swarms. Our main goal is to lower the entry barriers to cooperative-robot systems for undergraduate and graduate students. The testbed provides a high-level programming environment that allows the implementation of Timed Input/Output Automata (TIOA). SyROF offers the following unique characteristics: 1) a transparent mechanism to synchronize robot maneuvers, 2) a membership service with a failure detector, and 3) a transparent service to provide common knowledge in every round. These characteristics are fundamental to simplifying the implementation of robotic swarms. The software is organized in five layers: The lower layer consists of a real-time publish-subscribe system that allows efficient communication between tasks. The next layer is an implementation of a Kalman filter to estimate the position, orientation, and speed of the robot. The third layer consists of a synchronizer that synchronously executes the robot maneuvers, provides common knowledge to all the active participants, and handles failures. The fifth layer consists of the programming environment. In natural disasters, the response time for the search-and-rescue team is a critical factor to minimize the casualties. A swarm of robots, e.g. drones can be used to concurrently sweep the region to minimize the response time without risk to the search-and-rescue team [12]. Some researchers have followed a centralized approach where the robots are supervised and operated from a central control [5], [2]. However, these solutions are not scalable and are prone to failure. More robust solutions focus on fully autonomous systems, where the robots self-coordinate their actions without the help of preexisting infrastructure [1]. However, the implementation of these systems requires an interdisciplinary team with expertise in robotics, distributed systems, wireless sensor networks, etc, making the systems accessible only for experienced research teams. In this paper we present a testbed, called Synchronous Robotic Framework (SyROF), that gives access to undergraduate computer science/engineer at California State University Long Beach to rapidly implement and demonstrate robotic swarms. In essence, SyROF provides the look-compute-move model proposed by Suzuki and Yamashita in their seminar paper [14]. In our framework, robots broadcast their state infinitely often. Then, every participant robot obtains the state of every other active robot using a membership service, which can be used to compute its next movement. In the look-compute-move model, we can distinguish two main variants: 1) the fully synchronous FSYNC, where all robots start the cycles at the same time [6], and 2) the asynchronous ASYNC, where no assumption is made about the cycles. We choose to implement FSYNC to reduce the complexity of implementing cooperative algorithms. The power of the model has been shown in [3], [18], [17]. However, SyROF can also be used to implement the asynchronous variant. We implement a synchronizer to execute the synchronized cycle. In FSYNC every robot has common knowledge, i.e., every robot knows that every other robot knows, and so on, the state of the participant robots. Thus, the output of any deterministic function is identical in all robots. However, their output can be conflicting if robots do not attain common knowledge. We consider wireless networks where messages can be dropped at any time which makes it impossible to attain common knowledge deterministically. To overcome the impossibility, we consider the stream consensus protocol proposed by Morales-Ponce et al., [8] that guarantees common knowledge at almost every time with period of disagreement of bounded length. In this paper we describe the design of SyROF testbed that consists of multiple assorted mobile robots including omnidirectional robots, drones and rovers. Each robot is equipped with a microprocessor, a gyroscope/accelerometer sensor, a flow sensor, a GPS like sensor and a Bluetooth chip. We design and implement a real-time publishsubscribe system as a base system. Then we design and implement a Kalman filter to compute the state of the robot that reduces the noise of the sensory data. Then we implement a synchronizer to synchronize the task of the robots. On top of the synchronizer, we implement a programing interface, called virtual machine, that allows implementing Timed Input/Output Automata. The main software architecture is shown in Figure 1. Our design allows adding external sensors such as small computers for more complex applications.

Block diagram



III.PROPOSED SYSTEM

The **Military Support and Rescue Robot** system is designed to assist military personnel in rescue operations, reconnaissance missions, and providing support in hazardous or inaccessible environments. The robot is equipped with advanced sensors, communication modules, and artificial intelligence (AI) capabilities to enhance situational awareness, perform search and rescue operations, and provide real-time data to command units.

1. Robotic Design and Mobility:

The robot is built with a rugged design to navigate through rough terrains such as forests, deserts, mountainous areas, and urban environments. Its mobility system includes durable wheels or tracks for stable movement, as well as articulated limbs for climbing, crossing obstacles, and accessing areas that are difficult for human soldiers to reach. The robot can be remotely operated or function autonomously depending on mission requirements.

2. Sensor Array for Environment Monitoring:

The robot is equipped with a wide range of sensors including cameras (infrared and night vision), LIDAR, ultrasonic sensors, and thermal sensors. These sensors allow it to detect obstacles, identify potential threats, and locate injured soldiers or civilians in need of rescue. The thermal imaging capabilities enable the robot to detect heat signatures, useful for finding individuals in low-visibility conditions or through smoke and debris.

3. Communication and Data Transmission:

The robot is integrated with a robust communication system that enables real-time transmission of video, audio, and sensor data to the central command. It utilizes secure communication protocols like encrypted Wi-Fi, 4G/5G networks, or satellite communication to maintain connectivity in challenging environments. This enables remote operators to monitor the robot's progress, control its movement, and provide instructions during critical missions.

4. Autonomous Navigation and AI:

The robot is equipped with AI-based algorithms for autonomous navigation, which allows it to move independently in predefined areas, avoid obstacles, and follow specific paths during reconnaissance missions. AI also enhances its ability to identify objects or individuals of interest, such as injured personnel or enemy threats. Machine learning models are integrated to improve its recognition and decision-making capabilities in real-time, adapting to changing conditions on the field.

5. Rescue Operations and Payload Capacity:

The robot has the ability to carry medical supplies, food, water, and communication equipment to injured soldiers or civilians in remote or hazardous locations. It is equipped with arms or grippers to pick up, carry, or transport objects and, in some cases, evacuate small injured personnel. The robot can also provide immediate medical assistance by delivering first-aid kits or life-saving equipment while waiting for human responders.

6. Surveillance and Reconnaissance:

One of the primary uses of the robot is for real-time surveillance and reconnaissance. Its camera systems (which include night vision and thermal cameras) can send live footage back to the command center, providing critical intelligence on enemy movements, terrain conditions, and other key factors. This data helps military personnel make informed decisions without exposing soldiers to unnecessary danger.

7. Remote Control and Command Interface:

The robot can be remotely controlled through a user-friendly interface, which allows military personnel to take full control during operations. The control system is accessible via handheld devices or computers, giving the operator real-time feedback from the robot's sensors and cameras. Operators can manually guide the robot or switch to semi-autonomous modes where the robot follows pre-defined paths or objectives.

8. Rescue Mission Automation and Alerts:

During rescue missions, the robot can autonomously search for survivors based on heat signatures, sound detection, or manual input from the control center. Once an individual is located, the robot can alert the command center and continue searching for more survivors, streamlining rescue operations and reducing human risk. It can also broadcast audio messages or signals to guide trapped individuals towards safer locations.

9. Power Supply and Durability:

The robot is powered by a long-lasting battery system with energy-efficient operation to ensure extended missions. The system includes solar charging panels for sustained operations in daylight. Additionally, the robot's components are designed to withstand harsh conditions such as extreme temperatures, rain, and dust, ensuring durability in various operational scenarios.

10. Advanced Threat Detection and Countermeasures:

In hostile environments, the robot can be equipped with threat detection systems that identify explosives, mines, or hazardous materials. With these capabilities, it can safely neutralize threats or mark them for human intervention. In some configurations, the robot may include defensive tools to protect itself and nearby personnel from immediate threats.

The **Military Support and Rescue Robot** is a versatile solution that enhances the effectiveness and safety of military operations by providing autonomous support in critical tasks like reconnaissance, threat detection, and search and rescue. It reduces risks to human soldiers while improving operational efficiency in challenging or high-risk environments.

IV.CONCLUSION

The construction of the Military Support and Rescue Robot will be done in four stages. The sensing circuit is the first stage of the robots. The sensors are used to examine the atmospheric makeup and determine whether it is appropriate for human contact. An analogue signal is emitted by the sensors, which the Arduino picks up to display on the LCD and communicate over Zigbee to the main PC. The Pick and Place arm, which is used in the second phase, is programmed to be managed by the control buttons visible on the PC. The robotic arm is designed to both shift obstacles in the robot's path and detonate explosives. Phase three involves wireless data transmission from the site to the PC and TV tuner control of the camera. The last stage involves integrating all the previous ones into a single PC software that creates the GUI The prototype is a battery-powered, semi-autonomous military support and rescue robot that was created to address all of the major flaws in the existing models and create an all-in-one robot designed to operate as efficiently as possible. According to the findings and discussion, the suggested system outperforms the shortcomings of the current systems and supports military activities more effectively.

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