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A SMART MOTION DETECTION SURVEILLANCE ROVER WITH NIGHT PATROLLING FOR SAFETY AND MONITORING PURPOSES

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Abstract—Security is a necessity of every human being. The need for security has grown as the population has grown. However, adequate security cannot be set up for want of resources. It needs a large price, which not everyone can afford, to ensure appropriate security. The purpose of this project is to address the issue by creating a smart robot that, while taking into account long-term impacts, can offer high-quality security at a price that is significantly less.

A security patrolling rover that covers a specific region is proposed in this concept. The robotic rover follows a predetermined course and has a laptop camera, an IR sensor, and a sound sensor. The rover employs the technique of maintaining a predetermined line while patrolling. It can listen for sounds in the environment, and when any are heard, the rover slows down or stops completely while the camera records and transmits photographs of the scene or a person's face. The issue is then further examined to see whether it is an unusual activity or not, and after that, a message is sent to the local police station. Therefore, we present our model, which continuously and autonomously patrols a predefined area to secure the area.

Index Terms— smart robot, laptop camera, IR sensor, Sound sensor, patrolling rover

I. INTRODUCTION

The world is quickly moving towards modernization, which means that it is flourishing to develop both new and old technological features to their utmost potential. One such sector that is now a hot topic all around the world is security. Although the security industry has made advancements in the development of current technology, it has not yet fully embraced technology. Several technologies exist that can help to ensure security. Security cameras, like CCTV, are one of the most common forms of surveillance equipment and are present in practically every building and even on the roads. Although this kind of security technology does not aid in crime prevention, it does help law enforcement locate criminals after a crime has been committed.

Several technologies will be combined to create the "Smart Motion Detection Surveillance Rover with Night Patrolling for Safety and Monitoring Purposes" described in this paper. It may be utilized both inside and outside, as a surveillance camera and preliminary alarm system with further development. To address some of the security worries, we suggested our concept, which is a patrolling rover utilized for security purposes. This rover keeps patrolling along the specified route that the user has chosen

The device stops and takes a picture of the situation, which is then classified as Usual or Unusual activity, and the situation is then reported to the nearest police station in the case of Unusual Activity. The model is equipped with infrared sensors to detect any obstacles in front of it and a sound sensor to detect any sounds in the area.

The STM-32F103C8T6, often known as the Blue Pill, is the brains of this design and is where all the code for other pieces of machinery is stored. A DC Motor and a Motor Driver are also included, with the DC Motor being used to move the device left, right, forward, and backward, and the Motor Driver being used to operate the DC motors. to distinguish the object as a person, chair, watch, etc.

Libraries like OpenCV, TensorFlow, and Twilio are employed. This model was developed to address the growing crime rate in our neighborhood, and we recommend this prototype as a remedy.

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II. RELATED WORK

In paper [1] To integrate many current technologies, including wireless communication, neural networks, and hardware controllers, into a system that could carry out the duties of a night security guard while omitting human error factors such as night vision restrictions. The robot can move about alone, avoid obstructions, and notify the control room of any irregularities. It is autonomous. This minimizes human work and misery while also eliminating human mistakes. Obstacles are identified using sonars, and the location is determined using a GSM module.

In paper [2] With the use of a surveillance robotic system, a human may simply keep an eye on any given region from a distance while also controlling the robot online. Due to this system's extreme robustness, security forces can use it to monitor an area in places where human intervention is challenging. The different machine learning algorithms may be used to analyze live video footage to identify any individuals carrying a knife or other dangerous weapon with an accuracy of 93.72% and 81.23% for both the individual and the knife. Once a weapon-wielding person is discovered, the SMS alert notification can be successfully obtained.

In paper [3] This gadget is an intelligent, autonomous approach to conducting night vision patrols. It entails building a security robot with a night vision camera to ensure the security of its surroundings. Security would surely enhance significantly with improvement. In this study, a technique for building an observation design robot is suggested. The issue of restricted extent observation is resolved using the IOT idea. By using a PC or portable device, it is possible to physically monitor the robot by capturing the appropriate photographs and changing the camera's exposure, shutter speed, and other parameters. While creating the entire system, the hardware and software components were divided into units. The system was more effective with less debugging time after being tested in every area. The outcomes for both hardware and software are shown below.

III. METHODS

A. Block Diagram

Figure 1 displays the block diagram of the suggested system. The STM 32 microcontroller is the rover's brain. The STM32 - F103C8T6 has been used.

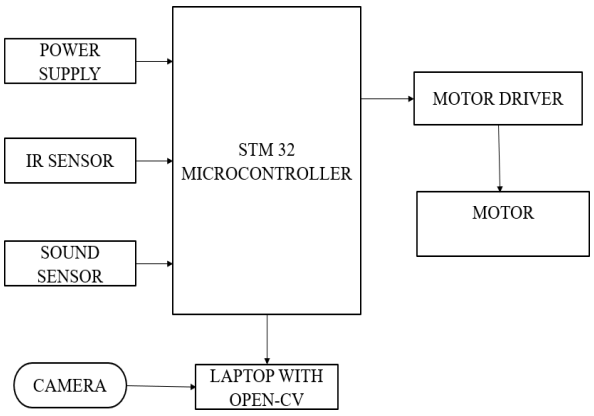

Fig. 1. Block Diagram

The STM32 Microcontroller is utilized to operate the robot. A controlled power source is used to provide the rover with continuous power. A sound sensor is used to detect any loud noises that are above a threshold value, and an IR sensor is used to identify obstructions in its route.

The rover is moved in all directions by a motor driver and motor. The STM 32 receives a signal from the IR sensor when it notices an obstruction in front of it. The motor driver then receives instructions from the microcontroller to alter its line of travel to avoid obstruction. The sound sensor continuously checks the analog readings, and when they reach a threshold value that indicates loud noise, signals are transmitted from the sound sensor to the STM 32, which subsequently transmits signals to take pictures and videos of the area and do additional image processing. The IOT network then analyzes the photos and videos that were recorded. An alert message with the location is sent to the police station if any odd activity is discovered.

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B. Image processing

1. Video acquisition: It is the process of obtaining the video using a piece of video-capture equipment, such as a CCTV camera, mobile camera, USB camera, or handy cam.
2. Frame conversion: After the video is captured, it is converted into frames of the right type so that additional processing can be done quickly.
3. Pre-processing: To cut down on noise, some pre-processing is performed on the video's frame data. Pre-processing techniques include the following: Smooth, Dilate, Erode, Median, Open, Close, etc.
4. Background modeling: It is the next stage to distinguish between the object and the backdrop after pre-processing. Backgrounds can be static or dynamic. It is one of the distinguishing features of any Background Subtraction system. This is a crucial system phase that occasionally may involve image subtraction procedures.
5. Backdrop subtraction: Any noticeable changes in the picture region due to the backdrop model are found in this stage, and the pixels making up the regions experiencing the change are then marked for further processing. To get the foreground, the backdrop is taken out of the original picture.
6. Post-Processing: The last step is to enhance the outcomes by post-processing. After backdrop modeling and removal, there are a variety of post-processing methods that may be applied. Enhancing the foreground mask is the goal of these strategies.
7. Foreground Extraction: This is the last stage in the procedure that removes the moving item from the frame. As a consequence, the Background Subtraction mechanism is improved.

C. Plan of Action

- This prototype may be used in real-world situations when the path has already been determined.
- The rover first follows the user-defined path.
- While the device is in motion, embedded components like the IR sensor and the sound sensor continue to function normally.
- The device's IR sensor is always looking for any impediments in its path.
- If an obstruction is found, the gadget halts, alters its course to the left, and then resumes onward motion.
- A threshold value is established once the STM32F103C8T6 reads analog readings from the sound sensor.
- The threshold value that has been specified signals that if an analog sound with that threshold value is heard, the device will stop.
- A signal is sent to the camera to take pictures of the scenario as it is happening once the gadget detects a sound that is greater or equal to the threshold value.
- Image processing is then used to further categorize the recorded pictures into Usual or Unusual Activities.
- The rover keeps moving along the predetermined course if the activity being monitored is normal.
- If not, a message requesting assistance is delivered, which is then utilized to direct further action by the necessary parties.

IV. RESULTS AND DISCUSSION

Hardware and software portions used were separated into units while developing the entire system. Testing every section of the system made it more efficient with lesser debugging time. Below are the results of both Hardware and Software.

1. Hardware:

Case 1: IR Sensor

Initially, the device was moving in a preset path. Whena obstacle was detected in front of the IR sensor, the roverstops and changes its path of motion by moving left andthen continues moving forward. By using a potentiometer the distance at which an object could be detected could be altered.

Case 2: Sound Sensor

Initially, the device was moving in a preset path. A thresholdvalue should be initially set. On detection of a sound whose analog value was higher than the threshold set, the device came to a halt and the camera immediately captured the video of the scenario. Image processing was further done.
Here, the threshold analog value which was set was 2000.

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2. *Software:*

Case 1: Detection of Knife

Here we have shown the image of a knife to the camera which has been identified as a weapon by the code implemented by us.

Figure 2 depicts the above-mentioned scenario

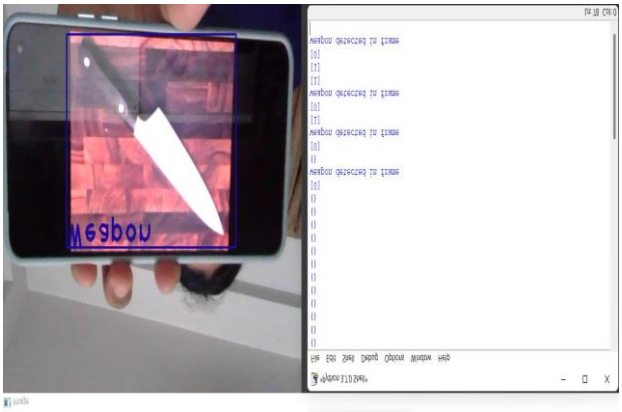

Fig. 2. Identification of a Weapon

Case 2: Detection of Gun

Here we have shown the image of a Handgun to the camera which has been identified as a weapon by the code implemented by us.

Figure 3 depicts the above-mentioned scenario.

Fig. 3 Identification of a Weapon

Case 3: Detection of People

Here we stood in front of the camera and the system identified us as a person successfully with an average accuracy of 99%.

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Figure 4 depicts the above-mentioned scenario.

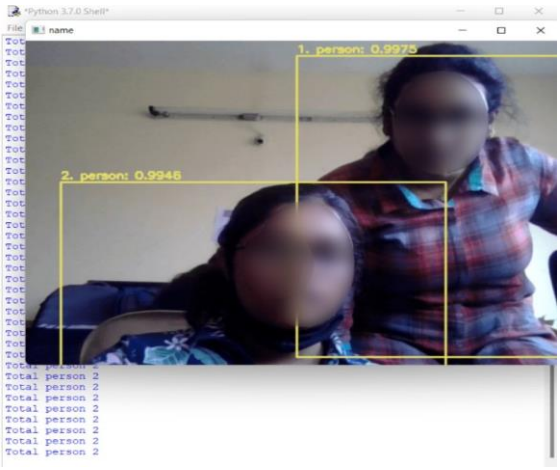

Fig. 4. Identification of People

The image of the weapon and person which is detected is sent immediately to the number provided. Figure 5 shows the screenshot of the image received.

Fig. 5. Screenshot of an image received

3. *Overall Setup Of Model*

Figure 6 depicts the overall connection of the microcontroller and all the sensors used and the connection of the motors used. We have made use of two motors which canhelp movement in forward, backward, left and right direction

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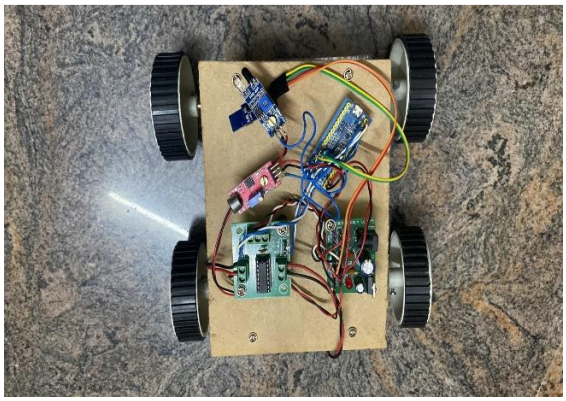

Fig. 6 Hardware Setup

CONCLUSION

The Smart Motion Detection Surveillance Rover with Night Patrolling lives up to its name. An intelligent system that can effectively patrol a predetermined area for safety and monitoring purposes may automatically avoid any obstacles in its route by altering its course of travel. It can simultaneously detect any loud noise, determine whether there is any odd activity, and then automatically send an emergency help message. These are the results reached based on the patrolling rover's design, implementation, and test conditions: All of the project's sensors are functional. The motor and motor driver allowed the rover to travel forward along the predetermined course without any problem. It could effectively recognize barriers of various sizes and forms by using the IR sensor to detect any obstruction in front of it. The rover may alter its course in the event of an obstruction and then go on moving without running into it. When a sound is detected by the sound sensor, the camera comes on and begins evaluating any sound whose analog value is equal to or greater than the threshold value, in this case, 2000. And able to identify persons and weapons using the image processing that was done on the live footage. If a weapon was found, a help message was sent right away so that the person in need may obtain assistance without delay.

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