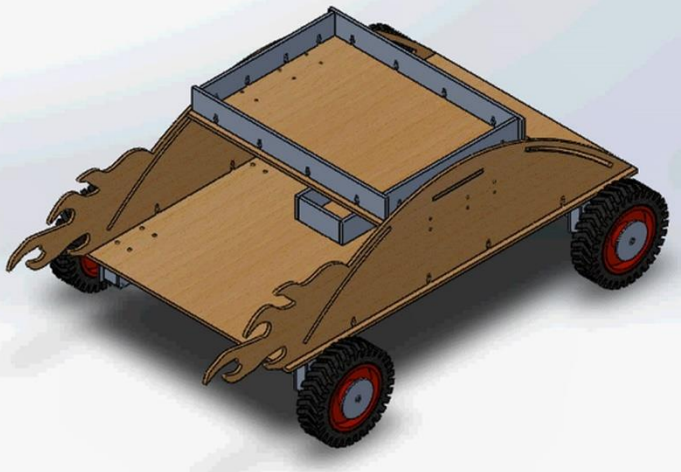
Mind Cloud - The Starks

Alexandria University

Team Names

Ayman Mohammed
Ahmed Tarek
Nourhan Hassan
Omar Mohamed
Ziad khalil
Ahmed Ibrahim
Menatallah Ashraf
Mohamed Selim
omar sayed
Omar Ehab



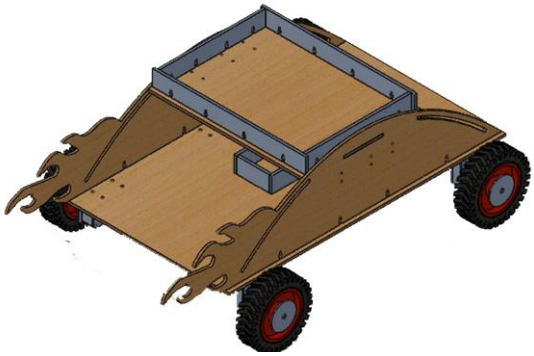
Supervision:
DR.AbdelSalam Olick

Abstract [Overview about robot/system] [250 words] (5 Points)

Remaining landmines is an obstacle in many countries to humanitarian aid, refugee return, economic progress. There is a clear need to mobilize additional financial and technical resources, especially to those countries emerging from long conflicts and suffering from this intractable problem. Our team pays great attention to that problem believing that clearing is an engineering duty and the humanitarian goal is a technical challenge. Our team is using a fleet of robots instead of relying on a single robot. Indeed, having multiple robots means an increase of robustness through redundancy. Besides, multiple robots can perform tasks in parallel and thus speed up the execution time, which can ultimately improve system performance. The starks multi-robotic system fulfils this task cleanly and reliably with the condition that upgrades, and cost are met. This prototype can be enlarged and used in real-world mine detection and save many lives. Our system is also ROS-Based with intelligent remote-command abilities in order to organize robot activities in a way that ensures robust, long-term highest-performance operation.
The robots were made to withstand the harsh environment of heat, terrain and unstable ground of the competition's arena. The power and control systems have been assembled and modified by the electrical team. The codes used were developed from scratch by the team's software engineers using Arduino to control the robot's algorithm and localization processes
Safety is the team's main priority within the scenario of demining. So, for example, many fuses have been added, the electronics 'system keeps the current from increasing drastically. Moreover, all parts are made with fillets.
The team usually starts working on new products with a brainstorming meeting gathering all team members, discussing ideas, improvements, sketching designs and reviewing the competition's manual for a better understanding of this year's missions. This process is mainly to ease the design phase and come up with an initial visualization of the project's structure.

Describe your mechanical design and locomotion system [250 words + image] (10 Points)

Several designs for different component configurations were proposed and debated. These designs we revised and modified until an appropriate design was reached which was compatible with 2018's mission. The robot's design was inspired by the shape of the Ladybug. The mechanical design is divided into two parts: The body is made of a polyethylene designed to protect the electronic components inside. There are four D.C motors (250rpm_20 kgf.cm) that are based on calculations for operating desert wheels and two free desert wheels with an encoder. There are also six fans in the body to prevent the temperature inside the robot from increasing. Finally, there arm to fix the coil to detect mines, and by that, the time of mine detection is reduced. Safety is our top priority, thus while designing the robot, safety was the main consideration. Our mechanical engineers designed safe parts with fillets and they used to end cap nuts to eliminate sharp edges.



Describe the landmine disposal and marking mechanisms [250 words] (10 points)

Our ROS multi-master systems allow the communication between the de-miner and the team leader first when the deminer detect presence of a mine next, it will move an acutely calculated amount of space(to let the team leader to stop in the mine position) then, it will send a command to the team leader to move from its previous location to the location of detected mine after that the team leader will autonomously start to move taking the shortest path to the detected mine location. Finally, the team leader will stop in the provided location and starting the marking process according to the type of mine and stay still until another command from the de-miner

Describe sensors and how can it detect landmines? [250 words] (10 Points)

There's only one sensor used in landmine detection.

Mine detector: It is considered the heart of the system and the most important sensor in the whole system because it detects the mines which is the main objective from the competition.

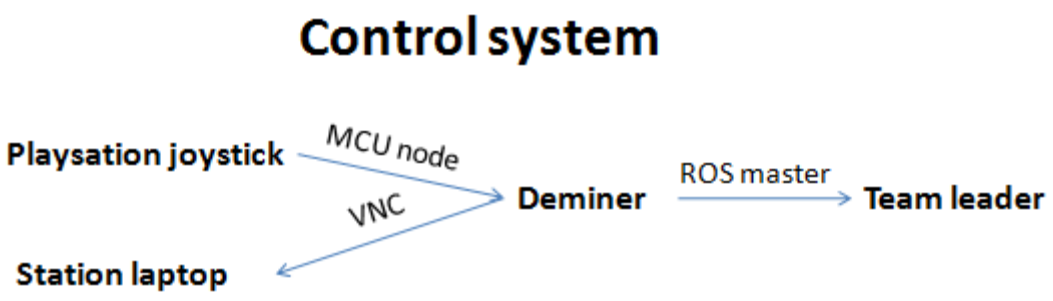
It is completely designed by our team members.

When electricity flows through the coil, it creates a magnetic field around it. Passing the **detector** above a **metal** object, the variation in the electromagnetic field measured by the mine detector determines the presence of a mine and determines whether it's a buried or a surface mine.

We will use colored coins to mark the mines

The mechanism we will use is by putting all the coins with same color in a cylinder and press them using compression spring and we will let an opening of about 1.4 the thickness of the coin and by using arm moves with reciprocating motion of 0.5 the thickness of motion we will push the coins out and to be in safe side we will put a barrier to limit the distance that the coin will be shorted

Describe your electronic circuit/control system/platform used [Teleoperated/Autonomous] [250 words + image] (10 Points)



MCU node (esp. 2688): is used to transfer the signals from the PlayStation joystick which controls the manual motion of the deminer wirelessly using the Wi-Fi module embedded in the node.

Ros master: It is the linkage between the deminer and the team leader in order to inform the team leader with the location of the mines which is provided by the deminer that guide the team leader movement.

In the end the whole system is connected together by a common network provided by a router

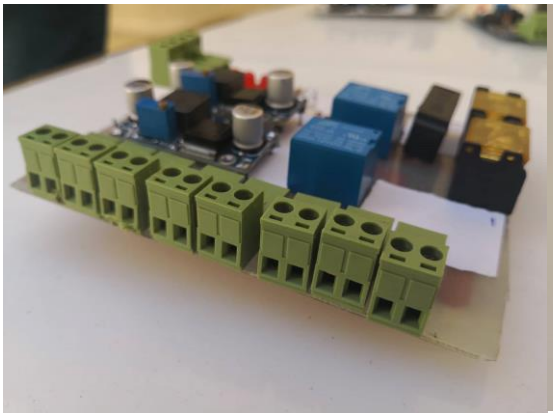
Platform

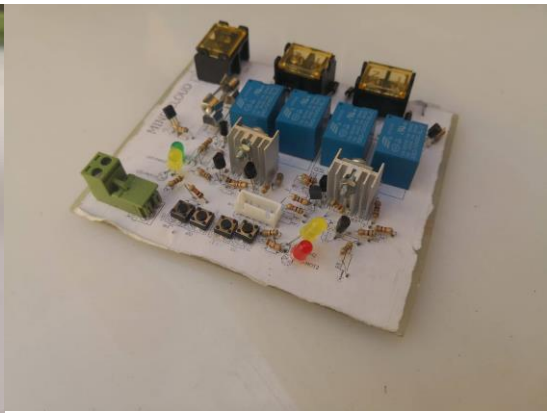
ROS is our main platform and our whole system is based on it as it provides us with a variety of benefits which services our as it has a communication which is ROS master also it helps us to connect the data collected by the sensor to the parts of the robots responsible for action. We also used Arduino to be our interface with the hardware. Furthermore, ROS was great help in linking multiple Arduinos together.

Electronic circuits

For motion, we use 4 DC motors each of them draws 4A max and has 200 rpm. We made 2 motor drivers to drive 4 motors using relays as H-bridge (Direction control) & MOSFETs to control the speed as PWM we design the driver depending on suitable torque and current as we choose the motors to do missions in the shortest time.

We made power distribution board as we need different voltage levels. For drive motors, Alarm, sensors, Arduino and other components. Its level such as (12V , 5V , 3.3V , variable volt)there is also a protection for this board like Reverse Polarity (by relays) , high current (by fuse & circuit breaker).we have also a battery indicator to know the battery condition at any time .(we made it by using LEDs & Zener diodes) for mine detection we made our metal detector as we designed and fabricated it using pulse induction theory and some electronics. It generates an analog signals to detect the mine which differs between surface or buried mine.





Put your plan to navigate the whole arena [250 words] (10 Points)

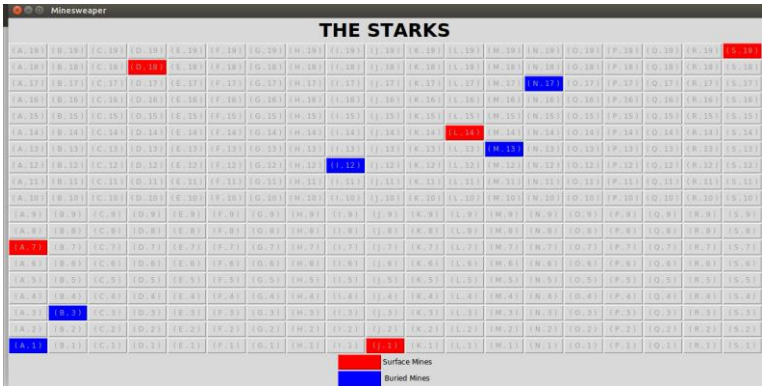
Like described in the overview our system is a MRS (Multi-Robotic system)
Our system consists of two robots, the first robot is called the de-miner and the second one is called the team leader.
Starting from the lower right corner, the de-miner(first rover) will start moving forward to sweep the first 20m of the first column, then it will rotate around its axis by 90 degrees towards the left side after that it will move forward for 1m then it will rotate another 90 degrees to the left to begin sweeping the second column reversibly (from the 19th meter until it reaches the 1st meter), and following the same algorithm it will continue sweeping the area until it detects a mine, then it will send the mine information to the team leader rover (second rover) which by its role will follow the suitable path to the mine and mark it.
Sensors used:

Compass: It's also considered one of the main parts of the system. The HMC5883L 3-Axis Compass module can measure magnetic fields in three directions: X،Y,and Z.
In our rover, we have only used it in 2 directions x and y. It's mainly used to determine the rotational angle of the rover which helps the rover in changing directions accurately when turning right or left and following the path to completely finish sweeping the field.

Encoder: It's the most important device in the mapping process. The encoder is the sensor of mechanical motion that generates digital signals in response to motion. As an electro-mechanical device, the encoder is able to provide motion control system users with information concerning position, velocity and direction.
In our rover, it's used only in position determination, it's connected to the system and continuously feeding it with position which is the main thing for the mapping process and helps us to simulate the rover's motion in the GUI and the Gazebo R.O.S simulation.

Describe how to provide the map of detected mines? [250 words] (10 Points)

In order to map out the whole arena the encoders provide the de-miner location represented in the robot's (x,y) coordinates and the sensor detect presence of mines either surface, buried or none , Data collected by each sensor are all sent to ROS where preliminary data processing is performed for the robot navigation. The data is stored into data structures headed with a message to identify what the data type is and is then sent to the host computer (de-miner computer) where the data is displayed by a graphical user interface. simultaneously, the GUI will be displayed on the guest computer in the control station via VNC connection.
VNC (Virtual Network Computing) grants the station laptop access to the laptop on the deminer to view its desktop which will be showing the mapping of mines and the connection will be a real time connection that will give the judge in the station live view for the mapping process.



How to face the rough environment and the high heat? [250 words] (5 Points)

As described in the mechanical design, the suspension system has helped the robot to overcome the harsh environment and we used wheels with suitable friction coefficient to make the robot moving in hard terrain environments such as rock, sand and grass.
Cooling system: We have used 6 fans in different areas of the robot. The number of operating fans depend on temperature sensor in the IMPU sensor. Carefully specified temperature limits are
used to control the number of these fans.
We chose polyethylene to resist high heat changes also to reduce the weight of the rover due to its low density and low thermal conductivity
We used wheels with suitable friction and motor with high torque to make the robot moves in hard environments

Put your Video YouTube link here:

https://urlzs.com/J1jwM