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Multi-function intelligent robotic in metals detection applications

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Abstract

Recent technologies for robotics have been offered an effective and efficient solution to safeguard workers from risks in their work environments. These risks involve radioactive, toxic, explosive and mines. In this paper, design and implement computer robot based on metal detection as well as avoiding obstacles automatically. The proposed wireless controlled robotic vehicle can be used in metal detection applications such as landmine detection, obstacles avoidance, selecting best routing without imposing human's harms and workforce aspects. The robotic wheel can sense the obstacles that positioning at ahead of its path, and also avoids the obstacles forward, left and right of its routes. The robot is controlled by using Bluetooth wireless communication to interface between the controller and the implemented robot. Furthermore, sensor IR (FC-03) for the metal detector and used ultrasonic sensor (HC-SR04) for objects or obstacles sensing. The presented controlled robotic designed for desert and dry soil that can replace the human role in avoiding obstacles and metal detection capabilities. The produced robot was useful due to it can detect metals and avoiding obstacles consecutively besides it was effective to select the best route based on the intelligent technique that adopted, the predefined metals by using an intelligent decision maker for route finder in a flat surface environment.

Keywords: *arduino, embedded system, landmine detector, metal detector, robotic, sensors, ultrasonic*

1. Introduction

In the digital era, several technologies have been innovated to serve most of our everyday activities. Recently, different terms of technologies such as robotics, Telecommunications, embedded systems, Internet of Things (IoT), etc. [1-4]. These technologies are innovated to major solved issues to save humanities life and efforts in diverse domains [5-8]. Many countries suffer from the legacy of explosives and mines in a postwar scenario for military security purposes [9-11]. A humanitarian demining process is a crucial and most dangerous mission that can be performed by personnel and anti-personnel (robotics) approaches [12, 13]. The traditional demining process (handheld metal detector) is employed to detect and de-activation of buried landmines. These process imposed hazardous tasks for human deminers due to it had high sensitivity to meager quantities of metal and issued enormous false alarm rates, so this mechanism is very dangerous and puts the deminer at the top challenge and risk [14-16]. Robotics is one of the convenient solutions for saving a lot of innocent people from killing and potential injury by mines and explosives that impose tenacious threats to humankind [17, 18]. Using robotics technology to perform several crucial tasks like to detect, de-activation, extract, demining is contribute to reducing humanity causalities as well eliminate threat the human's from the dangerous area [19-21]. Automated landmine detection using computer robotics or mobile robotics scanning platforms is an embedded systems and applications field [22-24].

Different attempts by authors have been made for research and development perspectives concern assist or automate human deminers in the humanitarian demining and scanning process to reduce efforts, time, cost, human risks and dangerous issues by proposing diverse efficient and suitable robotics landmine detection with several sensors design. [25, 26]. Recent robotics research involves various trends such as sensor technology, Ground-penetrating radar (GPR), Electromagnetic Induction (EMI), Nuclear Quadrupole Resonance (NQR) and so on to perform multi-functions such as detection, deactivating,

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extracting, and demining for explosive devices, cluster munitions, landmines as well avoiding obstacles. These trends can deploy in diverse soil kinds such as foliage, dry and desert soil based on Aerial and wheel techniques for landmine detection [27-29].

According to Jaradat et al. [30], designed a holonomic mobile robot based on that replace the human resources role in the demining process and applications for rough terrain. Bogie mechanism is used to overcome rugged territories, and the detection robot has the stability margins for different road conditions to predict the potential of a tipping-over before any maneuver [30]. In Gavilanes et al. [31], proposed an instrumented robotic arm to replace the human role in the demining applications [31]. While, Prado et al. conducted a sensor fusion model to classify landmines in a scanned floor area. The presented Bayesian decision level fusion enhanced the Probability of Detecting (PoD) landmines and decrease the rate of False Alarms Rates (FAR) [32]. Also, an efficient remote-controlled robotic vehicle produced by Alauddin et al. [33] to detect landmine and metals. The robot controlled via Android platform application based using Bluetooth wireless communication [33]. As alongside, Farooq et al., designed and fabricated an efficient wireless controlled robot to detect landmine in defence fields as well avoiding the obstacles robustly. H-Bridge module used to controlled robot wheels and wireless camera added to captures and located off the robot destination [34]. As well, Fattah et al. [35], proposed a precise control mine detector with aerial motion planning feature. The presented aerial landmine detection system able to provide the mapping of the points of metal signatures without effect rough terrain or inclined surface. The introduced framework evaluated respect to reliability and cost-effectiveness [35]. Furthermore, Ambruš et al. [14], presented a method to estimate the shape of magnetic metal targets using two different sensor platforms controlled by mobile robot based. The proposed method evaluated by simulations and experiments and the results of the target shape explicitly [36]. Besides, Zin et al. (2016), developed a mobile robot based to detect metals and avoid obstacles ahead of its path automatically in both houses and on flat surfaces. Methods involve using Arduino Uno R3 to control the mobile robot, Ultrasonic sensor to avoid the obstacles, inductive proximity sensor to detect metals with alarming issues when detected metal [37]. Likewise, a pathfinder robot is proposed by Agrawal et al. [38], the vehicle robot finds own route without human interferences to eliminate the instruction and human effort. The system used multi-sensor for several objectives such as it using an ultrasonic sensor to detect the path also a metal sensor to metal detection and Arduino for control robot to make system detection effective and efficient consecutively [38]. Also, Ghareeb et al. [39], presented an automated detector and extractor for landmine with concern to an active and low-cost system. Transmit and receive the detected data by server wirelessly. Information includes the location of the metal object and captured images of the land [39]. Finally, introduced an autonomous, efficient and low-cost system to mapping real-time any surface with depth value for landmine detection purposes. Microcontroller, MATLAB, and ultrasonic sensor are used to design the autonomous MinerBot detector [40].

This research focuses on metal detection issues. Also, the capability to detect mines, avoid obstacles, and finding the fastest and best route in a real-time environment. The proposing system using the concept of metal detection sensor and ultrasonic sensor, dimensions of the metal shape, wireless communication via controlled robotics vehicle remotely for flat surfaces and dry, desert soils to design and fabricate an intelligent technique for pathfinder without human harm.

The main contributions of this research are: (1) Design and implement a computer robot based on landmine detection purpose by using metal detection sensor. (2) Detects and avoids obstacles by the proposed robot vehicle that capable of discovered obstacles by using an ultrasonic sensor with online structured query languages database registry. (3) Conducted an intelligent decision-making technique for selecting the best pathfinder concerning metals and obstacles distances. (4) Robot detector can estimate the dimensions of the metal shape that underground or in the flat ground that detected from calculating length and width the target metal shape by robot wheel. The remainder of this paper is organized as follows: In section 2, describes hardware and software that required to design and fabricate the proposed robot detector. Section 3 introduces all steps and processes to implement the landmine detection robot. Besides, an intelligent algorithm for find best route is presents and highlights. In addition, results and discussion will be included in section 4. Whereas, section 5 concerns with conclusions and future directions.

2. Architecture of the Proposing Multi Function Robotic Wheel in Metal Detection Domain

The detector aims to detect an underground metal surface, calculate the dimensions of the metal exposed, avoid obstacles that positioned in the front, left, and right its path, as well find better and fastest route for a particular navigation area. This section describes the materials and method of the metal detector robot architecture. Hardware and software components are required to implement the robot detector. These elements were selected based on several criteria namely cost-effectiveness, usability, availability in the fabricated region, and ease of programming. The hardware components have needed for fabricating and testing the computer application based on controlling the detector. While Arduino UNO microcontroller boards as the brain of the system detection. Diverse sensors for detecting mines or metal, avoiding obstacles, and finding a fastest and better path in real-time settings such as metal detection sensor and ultrasonic sensor, dimensions of the metal shape sensor that will be explained in Section 3. Figure 1 presents the block diagram of the proposing metal detection system.

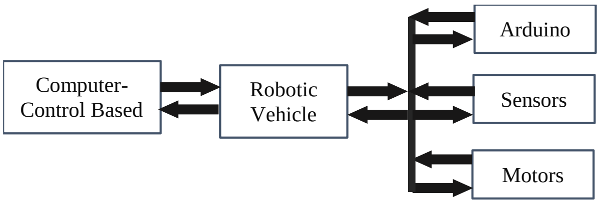

Figure 1. Block diagram of the proposed metal detection system

3. Implementation of the Proposed System Detection

This Section includes multi-phases to implement and fabricate the proposed robot vehicle. The first phase introduces a brief explanation detection mechanism of the robotic wheel. Whereas the second phased characterizes an intelligent technique to choose the pathfinder of the suitable route. Finally, the third phase discusses the shaping metal mechanism that detected in the mapping area.

3.1. Phase One (Robot Detector Metals and Obstacles)

Computer application based is designed via using a Visual C# program. To control the robot and move it to the current place for detecting the metals and obstacles consecutively. On the other hands, a microcontroller Arduino UNO board (ATmega328P) used as a brain to give instructions and analysis the results. Arduino microcontroller involves physical programmable circuit board and a piece of software that it runs on computer to be used for writing and uploading computer code to the physical board). Uno processes the received data from the computer, run the sensors, receive their results and analysis it to send it to the computer, run the motors and move the robot to the targeted place and stop the robot in case of a metal or obstacles disclosed and send an alert to the computer. Besides, the middleware between the computer and robotic circuit is a Bluetooth technology which is adapted to be the transmission channel between system peripherals wirelessly. That means some robot jobs can be done automatically and others based on computer instructions. Bluetooth is a short-range wireless connection between computers and peripherals. To move the robot, it must receive an order from the computer, then the microcontroller analyses the information and will give an electric current instruction to the motor to move the robotic into the selected navigating area. Figure 2 presents a flowchart that clarifies sending and receiving the information mechanism.

The pseudo-code which is explained in Figure 3, presented the pseudo code of the computer-based ordering to command the robot to be run and includes several instructions such as 1) Write the COM port number to activate and connect the Bluetooth technology of detector robot with computer end. 2) If the connection has done successfully, the status monitor with the show the instantaneous state of the robot, and that means the robot is ready to use. 3) To moving the robot, the computer will send an order to the robot via Bluetooth. Whereas, the primary function of the robot will recognize the received request and run the function of the movement of the robot.

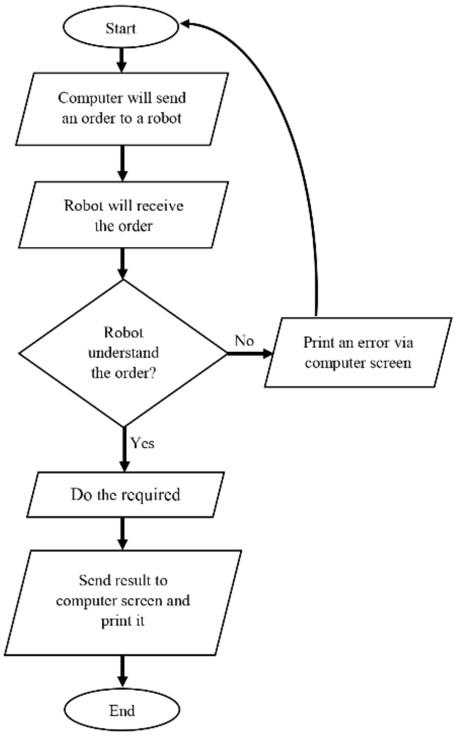

Figure 2. Flowchart of the mechanism of sending and receiving information

1 – $Bluetooth_{Robot} \rightarrow COM_{No.} \rightarrow bluetooth_{computer}$

2 – $if(connection() = success)$:

  a) $MonStatus[ASIZE]$ // 1D array to keep Moniter status Values

  b) $RobotReadyFunc()$

3 – $RobotMove()$:

  a) $MovementVar_{Computer} \rightarrow bluetooth \rightarrow MoveFunc(MovementVar)_{Robot}$

  b) $StartMoveFunc()_{Robot}$

Figure 3. Pseudo-code of communication between computer and robot

On the other hands, the robot used ultrasonic sensor (HC-SR04) which radiated ultrasound to detect and avoid obstacles. Figure 4 illustrates the robot scenarios of metals and obstacles revealed. The ultrasonic sensor (HC-SR04) is used to find out the distance between the robot and obstacles that are positioning in front of its route that controlled via Arduino. Obstacles distance have calculated based on the difference between time sending and receiving the radiated ultrasound by the ultrasonic sensor when a particular obstacle is discovered. The mechanism of disclosing obstacles are useful to decide on the best route if there are many routes in the mapping area. The system will analyse the received data and conclude the best way via charts as we discuss in details in phase two respectively.

Figure 5 discuss the Ultrasonic sensor that calculates the distance between the robot and discovered obstacles. This function is done by several steps of instructions which implements by the following steps: 1) the computer will send the order to the robot by the Bluetooth, the main function in the robot will recognize the order and run the function of getting the ultrasonic run. 2) The ultrasonic will send the ultrasound and wait to receive it. 3) The function of calculating the distance will calculate the time between the send and receive the sound, and show the distance. 4) The calculated distance will send from the robot to the computer to explain it. 5) If the calculated distance less than 30cm the robot will automatically stop, and send that to the robot with alarm.

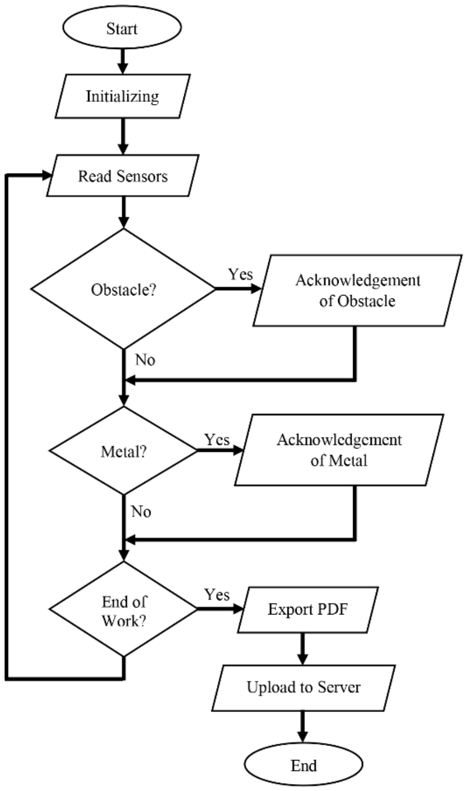

Figure 4. General flowchart of the metals and obstacles detector robot

$\mathbf{1} - \boldsymbol{OrderVar_{Computer}} \rightarrow \boldsymbol{UltrasonicFunc_{Robot}}$
$\mathbf{2} - \boldsymbol{UltrasonicFunc(OrderVar_{Computer})}$:
  $a)\ sendFunc() \rightarrow UltrasoundVar$
  $b)\ waitFuc()\ to\ confirm\ sound\ receiveing$
$\mathbf{3} - \boldsymbol{DistanceFunc(sending_{time}, receiving_{time})} \rightarrow \textbf{DistanceVar}$
$\mathbf{4} - \boldsymbol{DistanceVar_{Robot}} \rightarrow \boldsymbol{DistanceVar_{Computer}}$
$\mathbf{5} - \boldsymbol{if(DistanceVar < 30cm)}$:
  $a)\ \text{AutoStopFunc}_{Robot}()$
  $b)\ SendAlarmFunc_{Robot}()$

Figure 5. Pseudo-code of calculating the distance between robot and obstacles

3.2. Phase Two (Avoidance Obstacles Robotic Vehicle)

The detector robot consists of four tires that carry the metal sensors. The intelligence of the proposed system is concentrated in the ability to detect the obstacles and analysing the results to determine the percentage of the robot arrival for the required region [41, 42]. The robot stops automatically in case of the obstacle is positioned in the front of its rout precisely. The artificial intelligence technology can be known as the capability of a computer or other device to perform actions through an intelligence setting, also, the ability to make a decision based on past expertise or data, and the ability to understand spoken language.

From the obstacles detection point, there are two scenarios to detect obstacles and calculate the distance. The first scenario when obstacles are positioned in the front of the robot path (only one way) and the detector would send an alert if the robot disclosed a metal. Besides, the robotic detector will self-stops and then gives an alert to the computer-based depend on the status function. There is two behaviour that robot triggers an alarm, first behaviour when the robot moves forward to look for a metal or disclose an obstacle. While second behaviour when the mobile obstacles are moving in front of the robot. Then the robot will stops automatically when the distance between robot and obstacles is less than (30 cm) that be measured. Whilst, the second scenario if there is more than one way to reach a certain point or mapping area. Instead of that is entered into per way and see if any obstacles or not. The computer will send the order to the robot, and that will run a function in the robot, and the detector will run the three Ultrasonic sensors step by step respectively, and send the results to the computer, and the computer will show which the best way to navigated shortly is. This mechanism is used to discover each obstacle in multi-way as well, spent a short time to decide the fastest way to map it directly. All the results analyse and present in charts via the computer screen. Figure 6 introduces the algorithm of an automatic obstacles avoiding. Furthermore, the robot is responsible for determining the dimensions of the metals that are detected at the surface or embedded under the ground to record the details and percentages of their shapes and amounts. This procedure is most important for detection, deactivating, extracting, and demining purposes. As we discuss in more information in phase three.

The detector can determine the best route if there is more than one path in the mapping area and send results to the computer-based and displayed to make the best decision in a particular way. The intelligent technique illustrates the selecting of the best route in term of he navigation area that needs mapping and skimming respect to metals detection as well the system chooses the route that has the largest amount of the metals if found metals in many places (if we look at the most abundant minerals). Whether, the information that is displayed in computer-based and came from the detector, it collects as a data in a report, and upload to the database to determine the best report by the Manager in charge of the disclosure. For example, if there are three paths proportion of each is (20%), (40%) and (70%), where right path accounted (20%) because little of the obstacles found in this route. In the next phase, the measurement of the metal dimension is discussed in detail.

The detector system will analyse the results and display the data in charts via several steps that are: 1) all calculated values are sent to the computer-based. 2) The received values are stored for a short time in a text file, all the data is analysed. 3) The values of the distance of obstacles will analyse to display the best way. 4) Values of the dimensions of metals will analyse to show the largest metal. 5) All the analysed data will presents in charts. Figure 7 display the pseudo-code of the Results analysis and visualization.

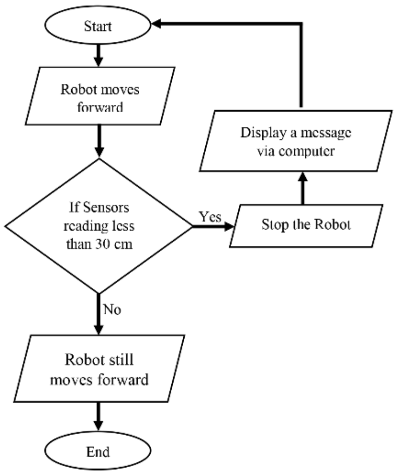

Figure 6. Flowchart of automatically breaking if the obstacles distance is less than (30 cm)

$1 - \boldsymbol{Results[ASIZE]_{Robot} \rightarrow Result[ASIZE]_{Computer}}$

$2 - \boldsymbol{StoredFunc(Result[ASIZE]): //Results\ analyzing\ Function}$

  $\boldsymbol{a}) \ TextFileStorage // To\ store\ the\ results$

  $\boldsymbol{b}) \ AnalyzedData[ASIZE] = AnalyzingFunc(TextFileStorage)$

$3 - \boldsymbol{AnalyzingFunc(ObstaclesDistances) \rightarrow \textbf{Choosing}\ Best\ Way}$

$4 - \boldsymbol{AnylyzingFun(Metal\ Dimensions) \rightarrow Choosing\ Largest\ Metal}$

$5 - \boldsymbol{ChartPlotingFunc(AnalyzedData[ASIZE]) to\ plot\ in\ visual\ charts}$

Figure 7. Pseudo-code of results analysis and visiualiztion

3.3. Phase Three (Calculate the Dimensions of a Metal Detection)

The intelligence of the proposed system is concentrated in the ability to detect the obstacles and analysing the results to determine the percentage of the robot arrival for the required region. The robot stops automatically when it discloses a metal and shapes and amounts of the number of minerals. When the detector starts skimming in the searching area, the robot will run the sensors of the metal detector. If the detector discovers a metal, the robot will stop in place and sends an alert to the computer-end, then the computer will display the received metal detection alert that there. The robot can measure the dimensions of the detected metal by using the IR (FC-03) to calculate the turn's number of the detector tires to find the distance that the robot has been walked.Hence, the distances measuring has done by running a function in the robot which it used the metal sensor and the sensor of the turns of the tire together to get the metal dimensions (Length and Width). If the function is run, the robot will move to the front of its path when the metal sensor is detecting the metal, whilst, the sensor didn't detect a metal that means there is no a metal in the skimming rout, and the robot will stop. The sensor measures the number of turns of the tire by using the mathematical formula:

$$[\text{No. of turn's} \times (2 \times 3.14 \times \text{radius of the tire})] \quad (1)$$

The presented formula can be calculated to find the measurement of metal detection in one dimension based on the robot walking in a metal as we shown in Figure 8. Hence, the measurement operation is required to repeat all robot walked but on the different side to measure the second dimension. Then the results will send to the computer-based to present data in charts view. The system will analyse the results and show the most extensive metal if there is more than one in the mapping area. If the metal sensor detects a metal, the robot will calculate the dimensions of discovered metal based on several steps can be illustrated as follows: 1) the metal detector sense the metal. 2) The robot will stop. 3) The robot will send an alarm to the computer. 4) The computer will send an order to the robot to calculate the metal length. 5) The robot will move on the metal will the metal sensor detect the metal, the sensor on the tire of the robot will calculate the number of tire rotation. 6) If the metal ends, the robot will stop and send an alarm to the computer and send the distance that calculated. Figure 9 shows the pseudo code of the algorithm of metal dimensions calculation.

(a) (b)

Figure 8. Calculate the dimensions of a metal detection (a) Sensor of the turns of the tire calculation (b) Side view of the metal detector shaping

```
1 − if(MetalDetectorSenesorVar_Robot = True):
        StopFunc()_Robot
        SendingAlarmFunc()_Robot → Computer
        CalcualteMetalLengthOrder_Computer → Rebot
2 − CalcualteMetalLengFunc()_Robot:
        MoveFunc()_Robot:
                WHILE(RobotMovementVar = True):
                        if(TireSensorDetector = True):
                                CalculateNoTireRotation()
                        Else:
                                RobotStopFunc()_Robot:
                                SendAlarmFunc()_Robot: → Computer
                                SendDistanceFunc()_Robot: → Computer
```

Figure 9. Pseudo-code of the metal dimensions calculation algorithm

4. Results and Discussion

A computer robot-based which is introduced in this study to avoid obstacles, detection landmines, Pathfinder, and shaping metal dimensions to avert humans risks in the mining environment. Whereas, the robot capable of detecting the obstacles that behind its path and detecting the metals underground (include landmines) by using an intelligent technique. The robot is controlled via computer which is connected wirelessly to implement orders. The information that is exchanged between robot and computer are transmitted via Bluetooth technology. And some of the related functions can the detector perform automatically without get an order from the computer side (windows client application) and send an acknowledgment to the computer. The robot sends results by Wi-Fi Ethernet-shield which is connected include the Arduino microcontroller. The system analysed gotten the data and display results by an intelligent algorithm. The testing way function is used if the robot detects an obstacle to examine the best route when there is multi-path there to select. The system has drawn several charts to display all ways and choose the best way one. As alongside, if the robot detects a metal, the system will calculate the dimensions of the exposed metal and draw printout several charts to display which has the largest metal.

The experiment results of the proposed metal detector robot present the detector is capable of detecting more than one metals kinds such as iron, silver, and copper efficiently in the navigation area. Based on table 1, there are five ways discovered by the detector in the mapping field. The results found by the ultrasonic sensors that connected with detector robot to disclose the obstacles. The results that are obtained from sensing paths are shown in charts to present the distance of the discovered obstacles that positioning at the front of the robot and to make a better decision for which route is better and fast to navigate it shortly.

Table 1. Five Ways are discovered in the Testing Process

Way No.	Left Path	Front Path	Right Path
1	10	300	70
2	100	500	100
3	60	50	10
4	20	20	20
5	300	300	300

Based on Figure 10, the system analysed the results and displayed in multi-chart. Whereas, chart 1 lists obstacles distances at the left positioning of the front of the robot detector path. So, there is an obstacle which it distance (10 cm) from the robot in the way No. 1 and there is an obstacle at distance (100 cm) from the robot in the way No. 2 and the rest obstacles distances in reminder five ways as follows respectively (60 cm, 20 cm, 300 cm). As a long side, chart 2 presents the distances of the detected obstacles via Ultrasonic sensor in the front of the detector positioning mapping area. Whereas, chart 2 contains obstacles distances of the five ways values as follows consecutively (300 cm, 300 cm, 50 cm, 20 cm, and 300 cm). Likewise, chart 3 views the distances of the obstacles at the right of the front of the robot navigator. The five ways values were (70, 100, 10, 20, 300) cm.

Depend on the results in chart 2, there is an obstacle on distance (300cm) from the robot in the way No. 1 and there is an obstacle at distance (300cm) from the robot in the way No. 2 and there is an obstacle at distance (300cm) from the robot in the way No. 5. Whilst, in chart 1 only way 5 has an obstacle distance is (300 cm) also in chart 3, way no. 5 has an obstacle distance (300 cm).

Whilst, chart 1 in Figure 11, illustrates all the previous three charts results in one chart (1, 2, and 3) in Figure 9 to present the five ways with their obstacles distances values that are detected via vehicle robotic. Respect to chart 1 in Figure 10, can be concluded is the better route is No.5 due to the distance of the detecting obstacles is high value (300 cm). Finally, chart 2 in Figure 10 provides the access ratio of the paths based on the results that displayed in chart 1 in such Figure. The intelligent system will analyses all the results in chart 2, and decide the best way which is the way number 5 due to the way No.5 has the high percentage which is (46%) of the proportion of accessing and that is right because the obstacles are far away from the robot in way 5.

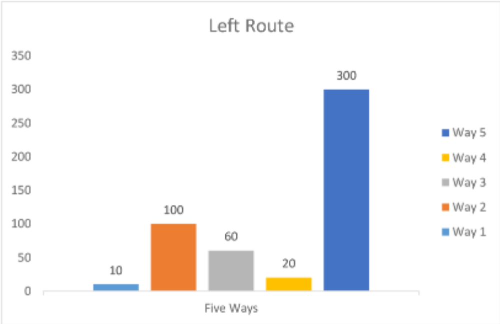

Chart 1. Left route

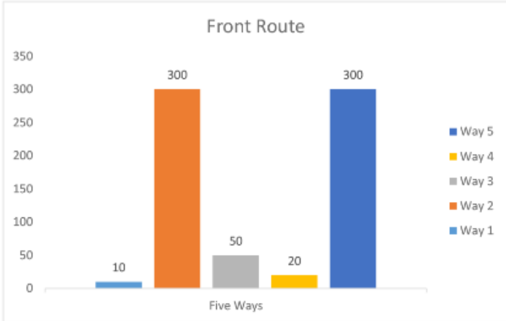

Chart 2. Front route

Chart 3. Right route

Figure 10. Charts of the five ways obstacles distances that detected in three direction (left, front, and right)

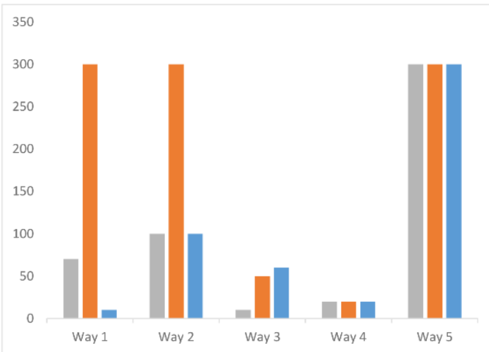

Chart 1. Distance of the detected obstacles for the five ways

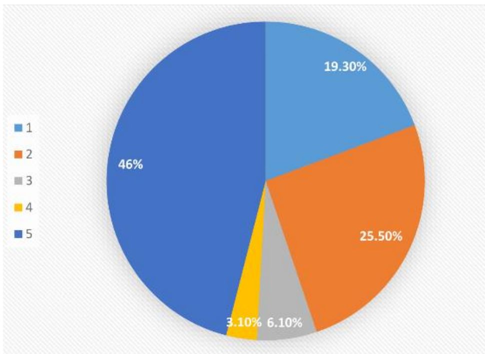

Chart 2. Five ways with ratio accessing

Figure 11. Intelligent Technique of Making Decision for Better Pathfinder via Charts of the Five Ways

In the experiment and testing end, three metals are discovered can be shown in Table 2. The results that obtained by using metals sensors via the proposed robot detector presents as charts as we demonstrated in Figure 12. The system analysed the results and displayed in multi-charts. Figure 12 includes two charts, one for the present the dimensions of the detection metals and the second chart to view the metal dimensions in ratio percentage. Based on chart 1 results in Figure 12, the discovered metal No.1 that has (20 cm) length and (30 cm) width, metal No.2 has (30 cm) length and (40 cm) width, and the third detected metal that No.3 has (10 cm) length and (20 cm) width. Whilst, second chart in such Figure displayed the percentage area of the metals which have detected. Hence, can be illustrated that metal No. 2 has a big area (length=30 and width=40) among other metals. Besides, chart 2 in

Figure 12, Metal No.2 has (60%) of the proportion of the metal dimension area by comparing with other detected metals like No.1 that had (30%) of the proportion of area and No.3 which had (10%).

Table 2. Three Metals Detection Dimensions in the experiment

Metal No.	Length	Width
1	20	30
2	30	40
3	10	20

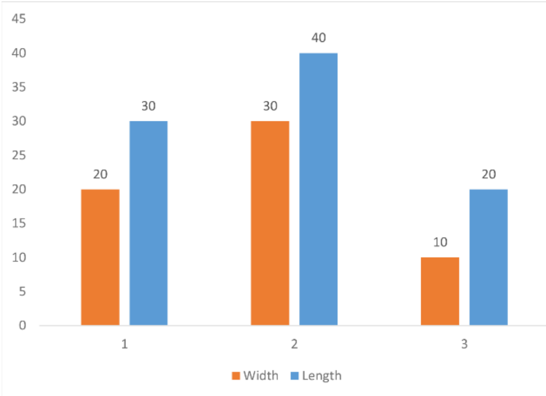

Chart 1. Length and width dimensions of the three metals

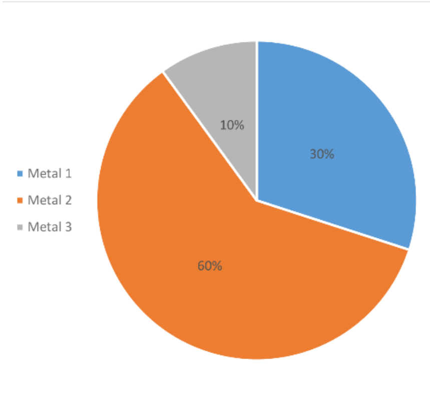

Chart 2. Ratio dimensions of the three metals

Figure 12. Charts of metals dimensions and metals discovered rates in experience

5. Conclusions and Future Works

This research focuses on the analysis and resolution of the issues in metal detection capability to detect mines, avoid obstacles, and to find fastest and best route in a real-time environment. These functions are done via the concept of metal detection sensor and ultrasonic sensor, dimensions of the metal shape, wireless communication via controlling the robotics vehicle remotely for flat surfaces besides dry and desert soils to design and fabricate an intelligent technique for pathfinder without human harm. Four contributions in this research are: 1) Design and implement a computer robot based for landmine detection purposes by using metal detection sensor. 2) Detects and avoids obstacles by the proposed robot vehicle that capable of discovered obstacles by using an ultrasonic sensor with online structured query languages database registry. 3) Conducted an intelligent decision-making technique for selecting the best pathfinder concerning metals and obstacles distances. 4) Shaping the metals that are detected by the proposed robotic wheel detector based on an estimate the dimensions of the metal shape that underground or in the flat ground through calculating the length and width the of the target metal shape.

Designing the integrated system which consists of a simple robot provided with the metal detector and using Bluetooth technology to communicate with its own software inside the computer. In the intelligent algorithm end, the robot can detect the obstacles in the front of its path, so if there is a multi-way in the navigation or searching area, the robot can identify the best way that has the lowest obstacles. Also, when the robot detects a particular metal, by an intelligent method the robot will discover the dimensions of such metal and analyse the results to present the largest area of the exposed metals. The robot will send the data to the computer, so the system will display the received data from the robot and analysed them immediately. The scope of the detection of metals depends on the sensitivity of the sensor type used. So, in the proposed detection robotic vehicle, the metal sensor can detect from 5 up to 7 cm underground flat surface. The sensor used can detect metals like aluminium, iron, and copper. The produced robotic is tested for more than one type of the metals, and the sense of the detection is depended on the size of metal. The intelligence of the proposed system is concentrated in the ability to detect the obstacles and analysing the results to determine the percentage of the robot arrival for the required region. The robot stops automatically when it discloses a metal to shape and amounts. This procedure is most important to be known to take the necessary preparing before thinking in metals mining. For the recommendations end, we can increase the distance by using another metal detector but it will be more costly. Problems have faced is to use the ultrasonic sensor, because the sound is propagated not straight line, so it may be gotten wrong alarms due to there is an obstacle at the side of the robot not at the front, so we can use a laser to avoid this problem, but it will be more costly. For further works, intend to extend the proposed system in multi-direction. To the detection stand for, using the arm with capture camera to make saver for human and robot detector as well as replacing sensors with better functions. While, from robot controlling based, design an integrated database system with an online registry.

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