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Development of a Smart Stretcher with Arduino Based Automation for Enhanced Patient Transport

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Abstract: The objective of the research is to build a remote-control stretcher using an arduino which is mounted with an explosive. The car is controlled by using a mobile app. The connection is patched using the bluetooth from mobile with HC05 bluetooth module connected to the arduino. The device is made versatile such that it is able to move every direction. The device boasts its versatility in moving freely and at respectable speed in all terrains with minor changes in parts. The device is made for free movement by boring the thought of various obstacles in various terrain and effects of weather changes. The device's main task is to rescue the injured soldier whose vital signs are down or hit by devising a route to the patient and returning in the same route avoiding all obstacles. The device is mainly operated by using the L293D shield which is a motor driver used to drive two motors operating the directions of the stretcher. The device moves as per the instructions given by mobile through the bluetooth module.

The device is wirelessly connected with the help of bluetooth which even helps in long range communication. This tactical lifesaver can be used in rescue and save a soldier's life without risking or involving other soldier's life. This device can also be used in hospital ambulance services to transport emergency patients to the correct ICU ward faster and correctly than humans. The device detects which ICU ward is not occupied with a patient and follows the routes set to the ward. This tactical lifesaver greatly helps soldiers to get out of a pinch situation with very less risk by involving very less involvement.

I. INTRODUCTION

The objective of our research is to build a remote-controlled stretcher with battery and BMS. The usage of the device makes it easy to fight in harsh terrains such as rough forests where soldiers have less spatial awareness, snowy places where moving is difficult and steep hills where climbing is difficult as the device can easily reach our allies with very less personal involvement. The device can be easily connected and operated with any mobile device using bluetooth. After the bluetooth receives command, the two motors are driven by the L293D Shield motor driver. This makes the stretcher versatile to move in all directions. The device is made such that it travels at a decent speed in all-weather terrains while carrying the injured. The stretcher body's preferred to be made using carbon fiber with a reinforcement of steel to make the stretcher strong yet lightweight for easy traveling. Glass material can also be used as replacement for carbon fiber but is more heavy compared. This way the stretcher can resist the blast force and also protect the soldier.

The device core operator is arduino with L293D Shield motor driver. The output and input components are connected and operated through arduino and shield driver. The bluetooth module is connected as an input device through which the commands are taken by the arduino and shield driver. The motors act as output devices which are operated with L293D shield. The circuit is also connected with BMS of the actual battery to operate the main servo motor. The device uses batteries as their power source. We are using a pack of 18650 lithium-ion batteries of rating 3.7 voltage and 4000 mah. The batteries are connected in master-slave BMS format with each other, so the total rating is 1176 khw.

$I_{total} = I_1 + I_2 + \dots + I_n$

Hence, $I_{total} = 4000 + 4000 \dots = 12000 \text{ mah}$ The voltage all together remains the same $V_{total} = 14.8 \text{ V}$

Material	Density (kg/m ³)	Tensile Strength (GPa)
Carbon Fiber (Standard)	1760	3.53
Titanium (grade 4)	4510	0.55

The hospital won't need a high-power stretcher compared to military use. The hospital mainly uses ultrasonic sensors to detect obstacles and IR sensors to detect threshold. The stretcher

The stretcher uses a servo motor for military purposes and dc motor for hospital purposes. The Servo motor is the latest replacement for the A.C motor Induction motor. Servo motor is said to generate higher starting torque and has less back emf on high speed which consumes less battery and runs for longer duration. The battery needs to be charged and can run for about 4 hours with no problem and 6 hours in low power mode. The BMS is used to maintain and run the battery in an efficient manner. The war may take place in an area where the temperature is not a friendly circumstance for the battery to run. To avoid this problem BMS always checks the outer and battery temperature and maintains the heat in the circuit by running 5V throughout the circuit.

The BMS uses a master-slave format with I2C communication where every four slaves have 1 master with a total of 4 masters. The masters are connected in a parallel manner and the slaves are connected in a serial manner. The BMS is a module which takes care of the battery and the motor circuit and helps them run in any harsh weather conditions.

The hospital won't be needing a BMS to handle the battery as the hospital always has a room temperature and the circuit is always ready to go. The brushless dc motor is a great motor to use as it is both silent and produces a great amount of power to run the stretcher. The brushless battery is able to run in reverse and forward direction effortlessly. The power ratings of various depend on the price put on the dc motors.

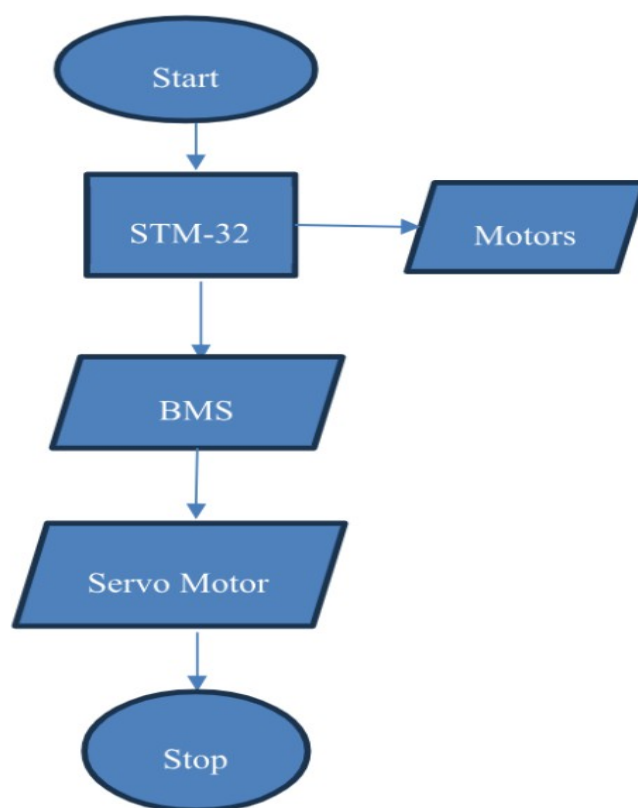


Figure 1. Flowchart of the driving circuit

II. LITERATURE SURVEY

In the research process, the team explored various papers and journals for learning the process and structure of the device. In many situations of war and terrorist incidents, the soldiers are being personally participated and risking their lives which places their job and national security in threat. To tackle this problem the team came up with this idea and we first focused on the tracking of the patient. The team took reference from [1] R. N. George, P. J. Zachariah, R. Mohan, M. Yaseen and B. John and from papers [2] S. Sarker, M. S. Rahman and M. N. Sakib [3] M. Syedul Amin, J. Jalil and M. B. I. Reaz. These papers mainly focused on GPS detection of location on satisfying a certain condition based by which the stretcher can be operated to enroute to the location. The team modified the stretcher such that it could perform well in all weather and terrain.

The team then focused on enroute to the location of GPS by finding the exact location through cloud and IOT applications.

[4] R. Rishi, S. Yede, K. Kunal and N. V. Bansode, [5] S. Gatade, S. V. Kulkarni and S. N., [6] P. Koganti, K. S. K., A. P., S. K. R., P. Kishore and S. R. Prasad refer various ways to detect and enroute towards the GPS using traditional ways by satellite communication and human interference. This method is rather helpful in precision basing on the remote control by human but there are some errors which can't be avoided. Therefore, the team goes deep into the topic of ML and research on the topic.

[7] M. Khosy'i'n, E. N. Budisusila, S. A. Dwi Prasetyowati, B.

Y. Suprpto and Z. Nawawi, [8] S. Filippou et al are the papers which helped around the way to use machine learning interface to detect and enroute the way through cloud without any human interface without any human interaction which reduces the time taken to process the information. This could open up a lot of opportunities for further development based on the system requirements and budget put on the project.

The team focused on the main part, that is to display the audio and video of the current live display through cloud network. The reference of this part was taken from the previous work of the author [11] A. K. Bandani, A. Bollampally, S. Sahithi, R. Naik,

N. Kumar and Goutham, the interface is similar and required for the extension of project. [9] Y. Yu and S. Lee and [10] M. R. T. Hossai, M. A. Shahjalal and N. F. Nuri were also used for reference to explore and make up for the other setbacks and to update and make a better updated model.

The team is working on making further developments by using artificial intelligence for self-driving. By setting the coordinates of location the device would be reaching the location and performs its task efficiently compared to that of a human. In this context the team is picking up preferences from paper [7] and is working on its research to make it possible.

III. PROPOSED MODULE

On taking the reference related to topic of research the team started adlib on the on the prototype and make it possible such that the stretcher is able to move the GPS location on remote control. The video quality and the audio quality are noticed to be low compared to the initially expected model. The main objective and the initial point of the prototype is the GPS signal. The GPS sensor sends information about location of the injured soldier when there is a drop in his vitals or he is injured which can be known by the bulletproof jacket worn by the soldier. The prototype alerts the nearby soldier to bring him to safety. The stretcher is enroute and controlled through remote and sent to the location. After the soldier is mounted, the stretcher returns on the same route with pace more than that of a human. This reduces casualties in war and helps in gaining an upper hand over the enemy. The stretcher mainly moves with the help of the servomotor and the DC motors helping in changing the direction of the stretcher helping as a great driving assist. The stretcher is able to move at speed of 60 kmph because of the power generated by the motor. The key role here is played by the cloud interface with its control over the sensors and alert the controller about the situation in war.

Similarly the team focused also on the alerting system as the stretcher can't automatically pick the soldier, the nearest soldier is alerted to pick and place on the stretcher. This system in a similar format can also be used for the hospital emergency but the GPS sensor is replaced with ultrasonic and IR sensor. The stretcher is also equipped with IR sensor and ultrasonic sensor for it follow the line and avoid any obstacles if detected. The ultrasonic and IR sensor measures threshold to recognize if the ICU ward is vacant or not.

IV. RESULT

The following pictures show the stretcher and the hardware circuit of the prototype. The prototype is being operated using Bluetooth simulation from our mobile as it is easier to operate and run the program and control the prototype.



Figure 3: Stretcher

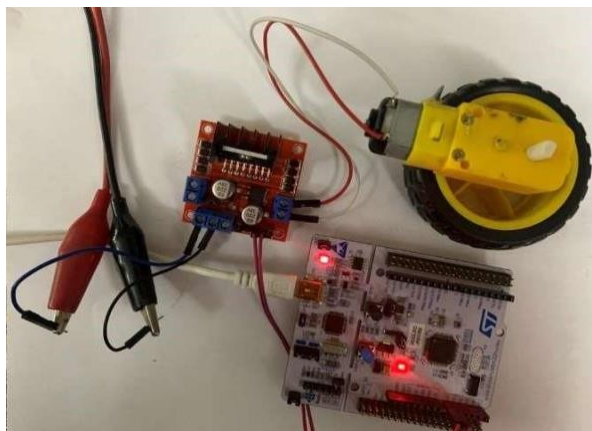


Figure4:Roughhardwarecircuit

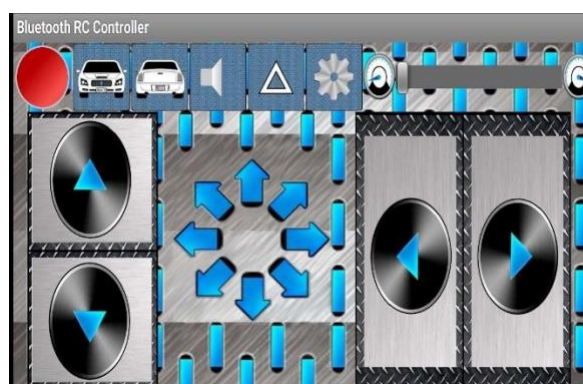


Fig.5.Simulation

V. CONCLUSION

As per commands the stretcher moves in all directions in versatile and speedy manner while carrying the patient on it. The robot doesn't involve any other human interference to move or to be personally involved in the task. The prototype has a lot variable options according to the demand of the user. By using AI assistant, the driving can become automatic without any human intervention and this makes the movements of the stretcher more precise and efficient. arduino is the most preferable board for AI applications in the price efficiency. This project has a lot of future scope and is pretty low cost. This could help strengthen our defense and reduce the number of casualties in war and helping the heroes of our country during the high time.

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