PROJECT PAPER

CSE341 (Microprocessors)

Submitted to

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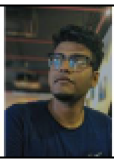
TEAM ALFRED



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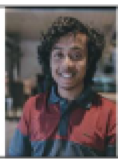

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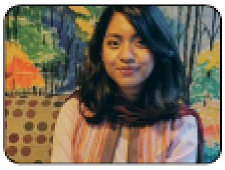

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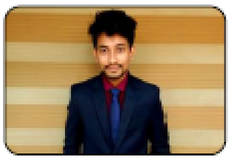

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Controlling All-Terrain Vehicle Using Bluetooth

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Abstract. This paper discusses about A-ATV (Alfred, All-terrain vehicle) which shall be able to traverse through almost all kinds of terrain and will be controlled via Bluetooth. The objective of this model is to be cost efficient and to perform exploration and rescue without risking human lives. The added features of Bluetooth control system, a camera and an emergency storage system give it the extra edge during rescue missions, studying areas and exploration. In this paper, we shall discuss about the hardware implementation of the A-ATV, how it works and why it is different from all other all-terrain vehicles.

Keywords: All-terrain vehicle, Bluetooth module, independent suspension.

1 Introduction

All-terrain vehicles have grown greatly in popularity in recent years and new features are being added in newer models. These features are based on the objectives or tasks it is expected to perform. But every all-terrain vehicle share one common property- it can travel on wide range of terrains- plains, such as mountain, canyon, desert, swamp, marsh etc. In our model we have decided to include an exciting new feature which is Bluetooth control. There is a common misconception that Bluetooth is a short ranged network. Rather it is a personal area network (PAN) with frequency of 2.4 GHz and coverage from less than 10 meters to 100 meters depending on the class of the device [1,2].
With the increasing number of natural calamities each year, rescue missions are more challenging than ever. Take earthquakes for example. Major earthquakes not only cause great deal of harm to human life but also cause huge destruction to infrastructures. More than 1.8 million people lost their lives due to earthquakes in the last century [3]. More often than not, there is no time for evacuation during an earthquake and if the infrastructure collapses, people get buried under it. It takes a huge amount of time to detect and rescue people from under the rubbles. Therefore, the A-ATV we propose can be useful in travelling through small holes or tunnels and ridding the rescuers from risking their lives. Moreover, it will consist of an emergency supply storage to send food, drinks or other objects. It can be operated using any

device that supports Bluetooth. Use of Bluetooth module allows the rescuers or explorers to control the vehicles themselves.

The A-ATV can also be used effectively in studying areas, getting information and exploration. With proper servoying snd delay settings, the camera will show the user where it is going and also give a vivid description of the surrounding areas [4].

After intense research, we were able to decide on the necessary equipment needed for this project and successfully implemented the whole system, but not without some initial difficulties.

The rest of this paper is organized as follows: Section 2 provides the literature review on existing models. Section 3 introduces the proposed model with the help of hardware description, a block diagram, a simplified flow chart and our program pseudocode. Section 4 describes the experimental analysis and the results of the proposed model. Lastly, section 5 concludes the paper.

2 Literature Review

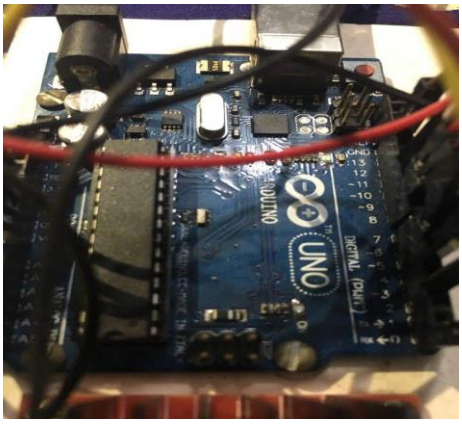
Our proposed model stands taller than the existing models in terms of effectiveness, ease of use and cost efficiency. In some of our studies related to ATVs, the proposed models are designed to be driven by humans [5,6]. For our model, any device compatible with Bluetooth would be sufficient to control the vehicle, therefore, the cost of having an independent controller can be avoided. Moreover, we will not have to worry about the controller getting damaged and anyone would be able to control it with their devices. We also used independent suspension in our model which will make it more effective in different terrain conditions [7]. Unlike the models we have encountered in our studies, ours is an unmanned vehicle which means it can be driven without anyone actually riding it [8,9]. This will prevent explorers and rescuers from risking their lives trying to go to risky places by themselves. We have deliberately made our model small in size which would allow it to go through tunnels and holes. We are using PVC for this model which is a good insulating agent and cuts the cost of building an ATV to a great extent as well [10]. Furthermore, we are using Li-Po (Lithium Polymer) batteries instead of fuel. Li-Po batteries are rechargeable and environment friendly whereas all fossil fuels are non-renewable and limited in amount [11]. Therefore, by using renewable energy, our model will also have a positive impact on the environment.

3 Proposed Model

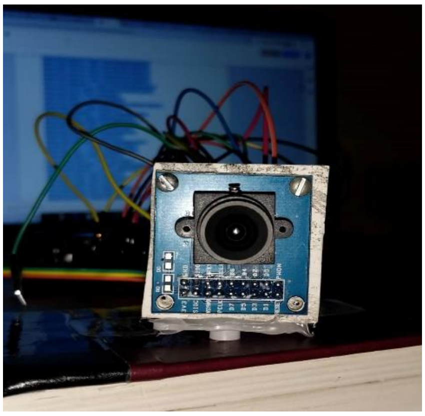
To elaborate our proposed model, we shall divide this section into four sub-sections: hardware description, a simplified block diagram, a chart of the workflow and our program pseudocode.

3.1 Hardware Description

Firstly, Arduino Uno R3 is used as the microcontroller which consists of 14 digital pins, 6 analog pins and programmable with the Arduino IDE, and is shown in Fig. 1(a). Secondly, The OV7670 Model Camera is shown in Fig. 1(b). Thirdly, 4 Motor Gears are used for regulating wheel spin. One of these is shown in Fig. 1(c). Fourthly, A SG90 Model Servo-Motor is used to control the linear positioning and delay of the camera, which is shown in Fig. 1(d). 4 Pololu Wheels are used and each of these has a spring attached and is supported independently of the others. These are shown in Fig. 1(e). The body of the car is made from PVC (Polyvinyl Chloride). The car body has 30 square inch storage space for carrying things.



(a)



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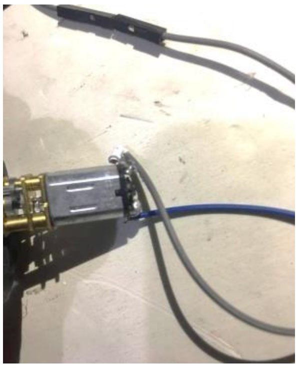


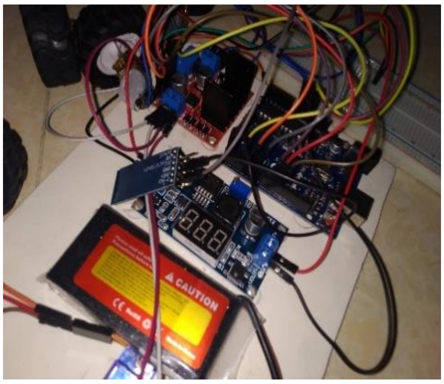
(c)

(d)

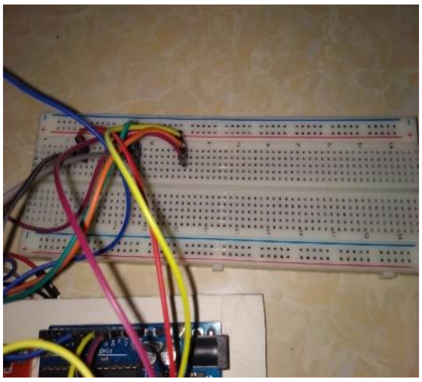
(e)

Fig. 1(a) Arduino Uno R3, (b) Camera, (c) Motor Driver, (d) Servo-Motor, (e) Pololu Wheels

Moreover, the car is controlled by HC-05 Bluetooth Module. It is a class 2 device. Bluetooth version is 2.0+EDR, data rate is 2.1 MBPS and frequency is 2.4GHz ISM band. The power of the car comes from rechargeable Lithium Polymer (Li-Po) Battery with 1100 mAh current and 7.1 Volt. Both the Bluetooth Module and the battery are shown in Fig. 2(a). The construction base for applying electronic connections is the breadboard and it is shown in Fig. 2(b). The voltage is regulated using a Buck Converter. We have used 5.1 voltage for Arduino Uno. The Buck Converter is shown in Fig. 2(c). Lastly, a L298 Model Motor Driver is used for driving motors attached with the wheels and is shown in Fig. 2(d).



(a)



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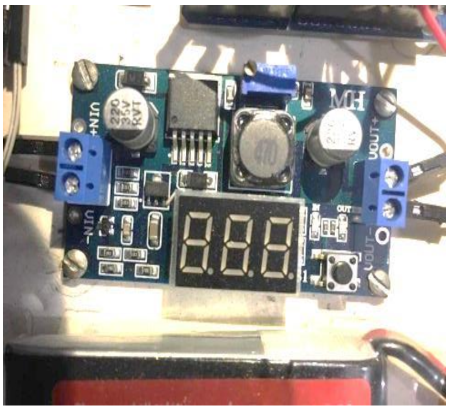

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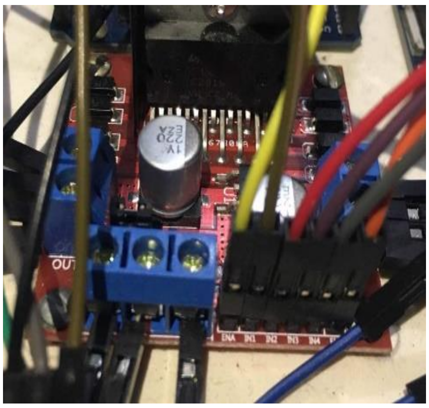

(d)

Fig. 2(a) Bluetooth Module & Battery, (b) Breadboard, (c) Buck Converter, (d) Motor Driver

3.2 Block Diagram

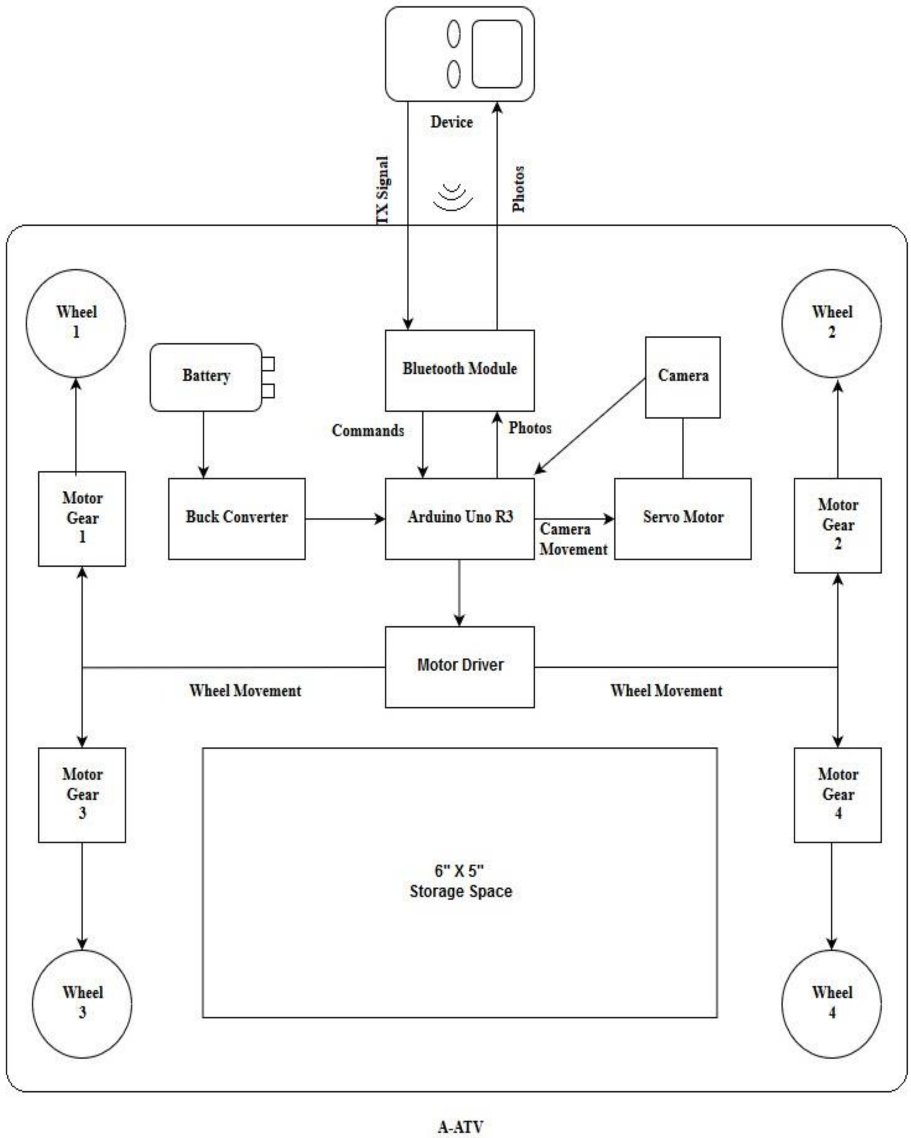

Fig. 3: Simplified Block Diagram of the model

3.3 Flow Chart of the Procedure

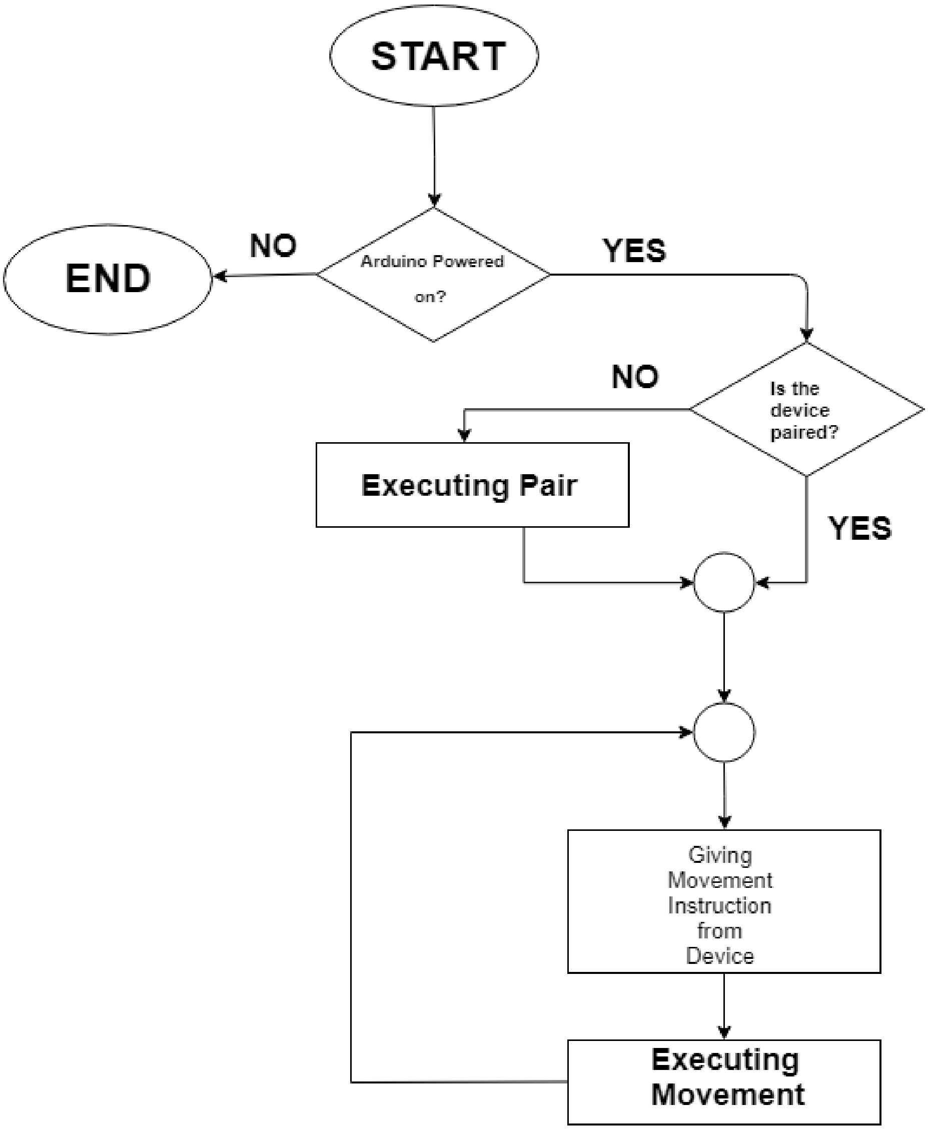

Fig. 4: Workflow of the procedure

At first Arduino is powered on. Then a Bluetooth enabled device tries to connect to the A-ATV. If it is not paired then it needs to pair first. Otherwise this step can be skipped. Then from the device through a Bluetooth RC controller mobile app, the user give the movement instructions and according to those instruction the A-ATV moves.

3.4 Program Pseudocode

Importing servo library;
Declaring voltages high and low;
Initializing high as 255 and low as 240;
Declaring servo pin;
Declaring object servo → 0;
Declaring character command

↦ Setup
Intestating servo with Arduino;
Setting pin modes for motor gears as Output;
Setting pin modes for Camera as Input;
↦ Setup end

↦ Loop
Setting servo angle to $45^{0;}$
Declaring servo motion for 1000 ms;
Setting servo angle to 90^{0};
Delaying servo motion for 1000 ms;
Setting servo angle to 135^{0};
Delaying servo motion for 100 ms;

For servo angle i=0~100, i++
Setting servo angle to I;
Delaying servo motion for 50 ms;

For servo angle i=180~0, i--
Setting servo angle to I;
Delaying servo motion for 10 ms;

If BI signal available>0
Then command= read from Bluetooth;
If command= 'F'
Performing method forward();
Break;
Performing method backward();
Break;
Performing method left();
Break;
Performing method right();
Break;
↦ Loop end

↦ Forward
Writing high on pin 10
Writing low on pin 11
Writing high on pin 9
Writing low on pin 6
Writing pwm speedA on pin 5
Writing pwm speedB on pin 3
↦ Forward end

↦ Backward
Writing high on pin 10
Writing low on pin 11
Writing high on pin 9
Writing low on pin 6
Writing pwm speedA on pin 8
Writing pwm speedB on pin 3
↦ Backward end

↦ Right
Writing high on pin 10
Writing low on pin 11
Writing high on pin 9
Writing low on pin 6
Writing pwm speedA on pin 3
Writing pwm speedB on pin 5
↦ Right end

↦ Left
Writing high on pin 10
Writing low on pin 11
Writing high on pin 9
Writing low on pin 6
Writing pwm speedA on pin 3
Writing pwm speedB on pin 5
↦ Left end

↦ Motors_stop
Writing 0 on pin 11
Writing 0 on pin 10
Writing 0 on pin 9
Writing 0 on pin 6
Writing 0 on pin 5
Writing 0 on pin 3
↦ Motors_stop end

4 Experimental Analysis

In this project, we have used individual motor gears for each wheel and each wheel has its own independent suspension. Each of the suspension can bend upto 45 degrees, allowing the ATV to stay leveled at all time.

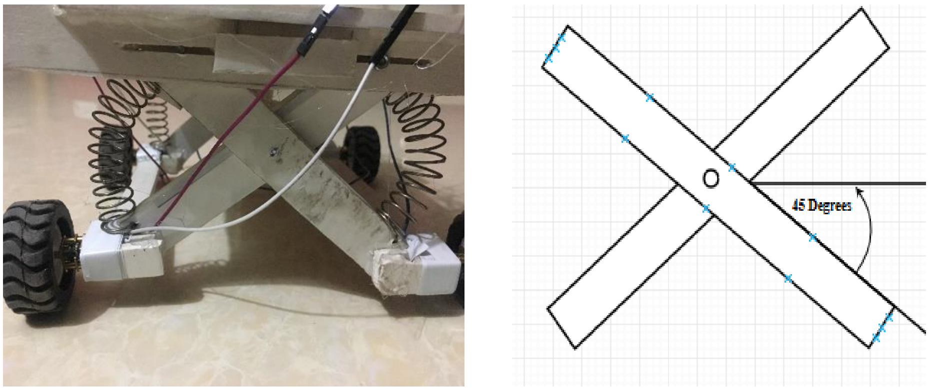

Fig. 5: Independent Suspension

We have tested our model on a variety of terrains like plain, grassy, uneven, muddy and sandy plains. The comparison of velocity in each terrain is shown in Table 1.

Terrain	**Average Time to Travel 5 Meters (seconds)**	**Velocity (m/s)**
Plain	15.9	0.0628
Grassy	17.2	0.0581
Uneven	16.8	0.0595
Muddy	26.3	0.038
Sandy	17.6	0.0568

Table 1: Comparison of velocity in different terrains

The camera gives still footage of the surrounding area after every ten seconds. It can be turned 180 degrees using the servo motor.

It turns out that, our model had the most fluency in plain surfaces and most difficulty in muddy roads due to lack of friction. Its performance in grassy, sandy and uneven terrains is also satisfactory.

5 Conclusion

In conclusion, our A-ATV has served its purpose to a great extent. But like all other technologies, there is still a lot of room for improvement. It was very difficult to build it in such short time and without any prior experience. We intend to keep on working on our A-ATV and enhance it by adding more features to it in the future such using Wi-Fi module, hand grapplers. The use of higher Bluetooth versions (e.g. v3.x, v4.x, v5.0) or a Wi-Fi module over Bluetooth 2.0 version would allow the vehicle to travel longer ranges without having the controlling device around it [12,13]. We intend to focus on increasing the velocity of the vehicle as well.
We gathered valuable experience from this project which will be extremely helpful in the future. We are highly thankful to our instructor for his assistance in this project.

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