

Hybrid of ATV (All-Terrain Vehicle) and AGV (Automatically Guided Vehicle)

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ABSTRACT: With induction of new technologies in electronics and mechanics it has given rise to a new field of mechatronics. Mechatronics have made machines very smart and automated reducing human effort. One such advancement has been seen by more use of AGV (automatically guided vehicle) in big industrial storage yards for transportation of required materials. In our project we have implemented same idea in ATV (all-terrain vehicles); this will make our vehicle choose its own path using its own artificial intelligence. Making vehicle choose its own path has been possible by using microcontroller. The ATV have designed it in such a way that it can also be controlled using cell phones to implement features of AGV.

KEYWORDS: Robotics, AGV (automatically guided vehicle), ATV (all-terrain vehicles), DTMF

I. INTRODUCTION

AGV (automatically guided vehicles) are used at many places for transporting work pieces from one working station to another using special guide wires and colored strips. They are gaining importance on large scale in areas wherein working of human can be very dangerous. Manually controlled bots are used to undertake stealth operations without knowing anyone. Many surveillance vehicles, drones are being used so as to have better defense preparedness. Manually controlled fire-fighting robots are also used where temperature is very high. Vehicles installed with explosive detector are used in military operations to detect explosives hidden under ground which is very helpful and has been saving many lives. They are also fitted with heavy machine guns; bomb diffusing bots have also been made.

Automated guided vehicles normally mean mobile robots (or unmanned vehicles) used in transporting objects. They were traditionally employed in manufacturing systems, but have recently extended their popularity to many other industrial applications, such as goods transportation in warehouses and container transshipment at container terminals. See [1] for an comprehensive survey of the research on the design of AGV systems. The booming of international trade spurs the development of automated container terminals (ACTs), equipped with automated container transshipment systems (consisting of automated cranes and automated guided vehicles etc.), that can meet rapidly increasing demands for higher operational efficiency, lower costs, and smaller variability than what traditional terminals can achieve

Many researchers developed and designed in order to suite with their applications which are related to the main problem of factory. Automatic Guided Vehicle (AGV) has firstly developed and conducted the research by Butdee and Suebsomran [2] and Butdeet al. [3] in the attempt to using at Jumbo Truck Manufacturing in Thailand. On the past of developed AGV, several papers was surveyed concerned to the design and control aspects as following. The different structures were proposed in several cases as Sung [4] proposed the architecture of AGV with two wheels driven by differential gear drive and parallel linkage steering, and the design and operation was also presented by Mentel and Landeweerd [5]. This path selection has been achieved in many ways by many researchers using Optical sensors[6], photoelectric guide way[7], steering wheel[8]. Sng Hong Lian developed an obstacle avoidance mobile robot [9] which is controlled by a Fuzzy logic controller which can also measure the distance and climb up the walls in which the Fuzzy

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logic concept was adopted. Dong-ying Ju worked on the development of Remote control and Monitors system [10] by using GPRS networking concept. Karthi Balasubramaniam worked on developing a robot for object recognition and obstacle avoidance [11] using the concepts of image processing and SONAR technology. Yen-Sheng chen developed the wheeled mobile robot [12] that utilizes signals of the ultrasonic sensors to avoid obstacle and fuzzy theory with sensor signals is used to control the speed of the wheeled mobile robot and make it move to target location.

In this manuscript, I am controlling a robot vehicle through wireless communication system using DTMF technology. According to the button pressed on the transmitting cell phone, the robot will move. The vehicle is also made operate using its own intelligence. Vehicle moves from one location to another in the same direction. In case any obstacle comes in its way it detects using sensors mounted on the chassis. After detection of obstacle it moves back about 1 meters then changes path to move ahead in same direction. Major change observed is in the suspension used in the vehicle. The individual suspension are such that they keep the chassis stable most of the time; which is achieved by using slider mechanism in the suspension of the vehicle. The repeated test done to modify the actions taken by vehicle and required changes ensured good performance.

II. DESIGN METHODOLOGY

Locally available hardware components and materials were used in design and fabrication of the vehicle. Structure of the vehicle was very simple in construction and small in size to minimize the cost and weight of the vehicle to have better mobility and performance. Hybrid of ATV and AGV, as shown in Fig. 1 was designed to move from one location to another. The detailed auto cad drawings and bill of material is as follows.

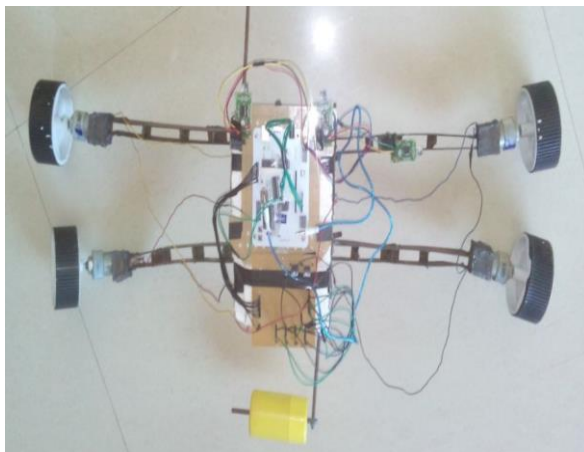
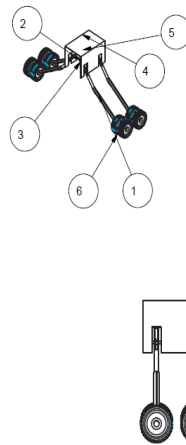


Figure 1



1	FINALASM	CONECTROD	4
2	FINALASM	PIN	4
3	FINALASM	SPRINGCONE	DIFFRODASM
4	FINALASM	SRTUCTURE	1
5	FINALASM	SUSPENSION	4
6	FINALASM	TYRE	4

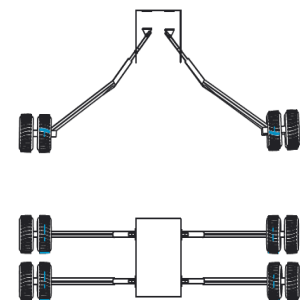


Figure 2

The bot consist of steel chassis used to mount suspensions and other electronic circuits. The bot is four wheeled which is provided with individual suspension to give more stability to vehicle. This is achieved by slider mechanism, as shown in Fig. 3 in it with one compressive spring and other tensile spring.

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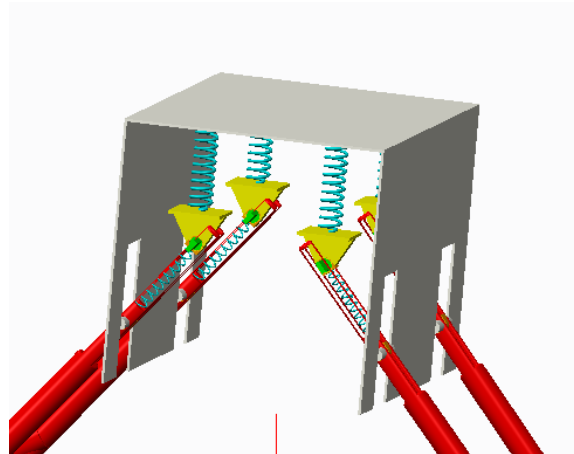


Figure 3

Design used to mount motors is very different from those used in actual situations. Normally wheels are mounted below the structure of vehicle, in our vehicle we have given connecting rod which is linked to suspension on one side and to the wheels on another side. This design enables the vehicle to move over the small obstacles of height of 6cms without change in its direction. High torque motors were used so that vehicle can move over obstacles very easily.

The electronic parts (microcontroller and sensors) were purchased from markets. High torque motors are used. Connections are made using wire to minimize the cost. All machining work is done in local facility. Sensors are mounted on the foam sheets to avoid damage caused due to shocks and impacts during tests and real working environment. Similarly, microcontroller is also mounted on foam sheets.

III. DRIVE AND CONTROL SYSTEM

The vehicle was four wheeled drive and on each connecting rod one motor was mounted which was run using the stimulus obtained from the sensors and the microcontroller. All motors were running at uniform current and voltage during forward motion of vehicle. The vehicle was provided with artificial intelligence using ATMEGA16 microcontroller, as shown in Fig. 4. The signals obtained from three sensors (two on the connecting rod and one on top of chassis) were used to give required motion to the vehicle. DTMF (dual tone multi frequency) module was used to control vehicle using cell phones. A DTMF keypad (generator or encoder) generates a sinusoidal tone which is mixture of the row and column frequencies, as shown in Fig. 5. The signal generated by the DTMF encoder is direct algebraic submission, in real time of the amplitudes of two sine waves of different frequencies, i.e. pressing 5 will send a tone made by adding 1336 Hz and 770 Hz.



Figure 3

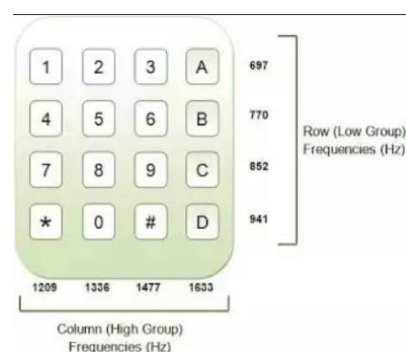


Figure 4

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Power is supplied to microcontroller through voltage control IC 7805 to prevent burning or overheating of microcontroller. Motors are connected to microcontroller through motor driver IC L293D and relays. Motors used are of 300 rpm and are geared motors. DTMF module HT9107 is connected to microcontroller and a headset for input from mobile. Sonar sensors HY SRF05 are used for obstacle detection with precision on about 1 meter and output in range on 5 V. Two sensors are mounted on front wheels, one on the body of the bot and one at bottom of chasses to determine height from ground. As shown in figure 5

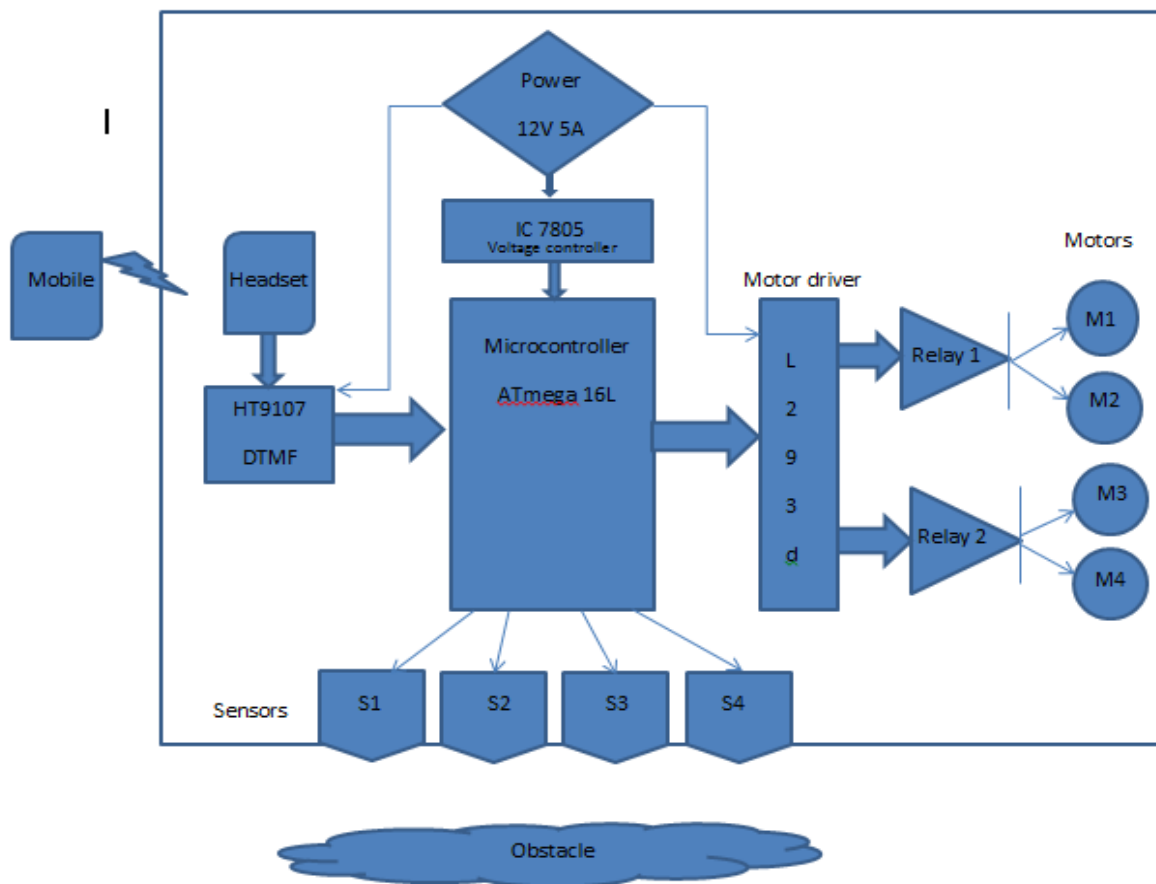


Figure 5

IV. ALGORITHM

The microcontroller ATMEGA16 was programmed as per above algorithm where inputs were taken from DTMF module through cell and proximity sensors mounted on the bot. Switch statement was used to obtain results where each DTMF frequencies were assigned with specific motion of bot. The switch 'A' converted bot into autonomous motion where it will move in straight line till it is obstructed by an obstacle. At every obstacle it will rotate by 10 degrees and move straight till next obstacle hinders its path. As shown in figure 6

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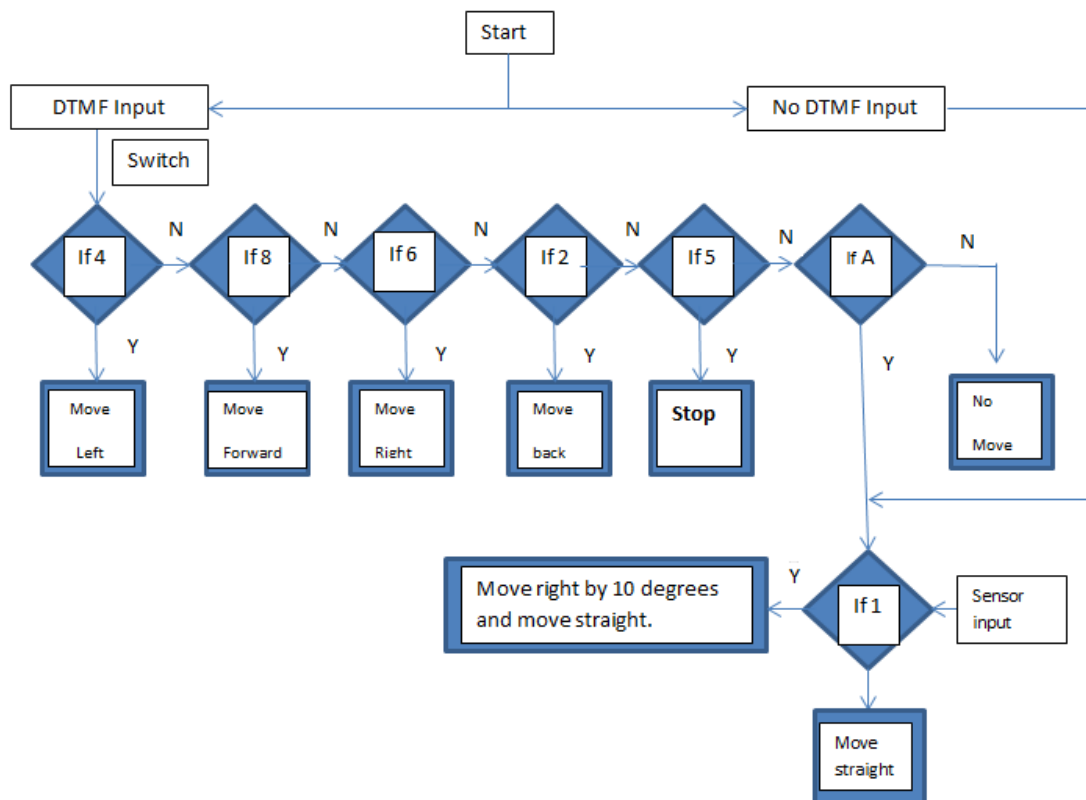


Figure 6

V. EXPERIMENTAL RESULTS

Problems:

- 1) Instability of bot during its movement was observed due to improper stiffness of springs.
- 2) Sensors were not able to properly detect obstacles on rough surface due to fluctuations in its position.
- 3) Improper mobility due to faulty programming

Solutions applied

- 1) Stiffness of bot was increased to attain satisfactory stability.
- 2) Position of sensors was changed to minimise fluctuations.
- 3) Programming was rectified several times to attain exact mobility.

VI. CONCLUSION

The design and development of bot was successful. Our algorithm successfully follows commands given by the cell and works efficiently in autonomous mode. The robot moves on surfaces with about 6cm of unevenness. The mobility of robot is satisfactory. In future scope bot can be tried and tested in battle fields and fire zones after certain modifications of algorithm and design.

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REFERENCES

- [1] D. Briskorn, A. Drexler, and S. Hartmann. Inventory-based dispatching of automated guided vehicles on container terminals. *OR Spectrum*, 28:611–630, 2006.
- [2] Butdee S and Suebsomran A, “Learning and Recognition Algorithm of Intelligent AGV System”, *GCMM*, pp. 13-72, 2006.
- [3] Butdee S and Suebsomran A, “Localization Based on Matching Location of AGV”, *Proceeding of the 24th International Manufacturing Conference, IMC24*, pp. 1121-1128, Waterford Institute of Technology, Ireland, 2007.
- [4] Sung E, Ng K Loon and Yin Y C, “Parallel Linkage Steering for an Automated Guided Vehicle”, *IEEE Control Systems Magazine*, October, pp. 3-8, 1989
- [5] Mentel R J and Landeweerd H R A, “Design and Operation Control of an AGV System”, *International Journal of Production Economics*, Vol. 41, pp. 257-256, 1995
- [6] Borges G A, Lima A M N and Deep G S “Characterization of a Trajectory Recognition Optical Sensor for an Automated Guided Vehicle”, *IEEE Transactions on Instrumentation and Measurement*, Vol. 49, No. 4, pp. 813-819, 2000.
- [7] Dianyong Y and Hui X, “Application of Fuzzy Control Method to AGV”, *Proceeding of the IEEE International Conference on Robotics, Intelligent Systems and Signal Processing*, October, pp. 768-772, Changsha, China, 2003.
- [8] Senoo S, Mino M and Funabiki S, “Steering Control of Automated Guided Vehicle for Steering Energy Saving by Fuzzy reasoning” *IEEE* October pp. 1712-1716, 1989.
- [9] Lian, S.H., “Fuzzy Logic Control of an Obstacle Avoidance Robot”, *IEEE International Conference of Fuzzy Systems*, New Orleans, LA, September 8-11, vol.1, pp.26-30, 1996.
- [10] Dong-ying Ju, “Development of Remote Control and Monitor System for Autonomous Mobile Robot Based on Virtual Cell Phone”, *IEEE* 5-7 September 2007.
- [11] Balasubramanian, K., “Object recognition and obstacle avoidance robot”, *IEEE 17-19 June 2009 Chinese Control and Decision Conference (CCDC 2009)*.
- [12] Yen-Sheng chen, “Intelligent Obstacle Avoidance Control Strategy for Wheeled Mobile Robot”, *ICROS-SICE International Joint Conference 2009 August 18-21, 2009*