Development of an Electronic Guide Stick and Roving Vehicle Using Wire Guidance Technology

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Abstract : Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness represents the lack of integration in the growth of the optic nerve or visual centre of the eye, and total blindness is the full absence of the visual light perception. The implemented system is cheap, fast, and easy to use and an innovative affordable solution to blind and visually impaired people in third world countries.

In this paper, a simple, cheap, friendly user, smart blind guidance system and roving vehicle is designed and implemented to improve the mobility of both blind and visually impaired people in a specific area. The paper includes the description of an electronic guide-stick to help the blind person and a roving vehicle to navigate alone safely and to avoid any obstacles that may be encountered, whether fixed or mobile, to prevent any possible accident.

The system is based on the infrared sensing system, a monolithic integrated circuit designed for metallic body detection by sensing variations in high frequency eddy current losses.

The paper shows how to build a self-made autonomous robot capable of following a guiding line. An easy principle on how the robot follows the line was explained. This paper will further describe how infrared sensors work and how to process their signal by the help of a NOT gate, LM 293D and LM 358.

Index Terms-LDR, Light Emitting Diode, Motor Driver Circuit LM293D, Op-Amp 358, Photodiode, Infrared Sensor.

I. INTRODUCTION

For a visually handicapped person to cross a street at traffic light junctions is hazardous as the person cannot identify the visual signal which permits the pedestrians to cross [2]. In several countries, an audible signal is also provided at these pedestrian crossings which indicate the blind [2] and other visually handicapped that it is safe to cross the road. The conditions in India are not so favorable. The vehicular noise is of very high volume and the density of vehicular traffic is also very high, leaving little scope for a blind pedestrian to cross these junctions safely. For a free roving vehicle in electronic fence, the fence is a single wire lead on the floor in a circle and which carries an alternating current of a frequency in the audio frequency band. The electronic fence is basically designed to provide an area for a vehicle to move freely within that area without any obstacle either fixed or mobile. The vehicle has an induction sensor tuned to the frequency of the wire loop. When the vehicle is near electronic barrier, the sensor on the vehicle picks up the signal from the loop wire and operates a relay which causes the vehicle to change the direction and move again.

The main purpose of an intelligent stick for the visually challenged is to identify the obstacles in front of the visually impaired and to locate the positions of different objects placed in his living room.

Alow cost and efficient navigation aid for blindgiving a sense of artificial visionabout the environmental scenario of static and dynamic objects around them is provided and presented a theoretical model and a system concept to provide a smart electronic aid for blind people [4]. Output is in the form of beeps which the blind person can hear. GPS and GSM are used to acquire the exact location of the blind person at the time of emergency [6].A novel electronic fence design was presented along with a track oscillator to investigate potential and specific requirements and challenges [7] and found to be compact,cost effective which meets specific requirements of non-lethal nature of the fence.A system was evaluated on a set of ultrasonic signals where stair-cases occur with different shapes to be detected in electronic cane. Using a multiclass SVM approach, recognition rates of 82.4% had been achieved. [1] Precise guidance for visually handicapped persons can be achieved by the application of wire guidance technology in conjunction with a specially developed electronic guide-stick. The principle underlying this technology is straightforward. A single insulated wire is laid by (or under) the floor and carries electrical signals which can be picked up by a sensorand processed through an electronics circuit.

This wire serves as an “electronic track”. A pickup sensor and an electronics processing circuit together with the batteries fits inside a hollow cane [3]. When the cane is brought closer to the wire a beeper operates. A visually handicapped person walking over the wire and holding the lower end of the electronic guide-stick close to the floor cannot hear the beeper if this person is on the track. Any major deviation from the pre-laid track will cause the beeper to beep. Waving the stick around, the signal can be picked up again, enabling the visually handicapped person to correct his direction and resume walking.

Guide tracks consist of one or more insulated electricwires laid on the floor. They may be visible or laid under a floor matting/carpet. They can even be buried under the flooring and covered with plastic or cement. In the latter case they should be sheathed in a plastic conduit to prevent damage to the insulation. Each wire should carry one signal; hence for multiple tracks we require a multi-core cable. Since the voltages and currents are quite low in these wires, special cables are not required. Multi-stand wires used for domestic wiring are quite adequate for this purpose.

The tracks start from the track power unit and lead up to the destination. They should return to the power unit by a different route to complete the circuit, but the return track must be kept away from the main track by at least two metersdistance. The distance over which a track can function depends on the strength of the signal. Theoretically this can extend over several kilometers. However, from practical considerations it is normally limited to indoor applications.

Several tracks can be laid from the power unit leading to different locations in a building complex or even from one building to another. This can be laid from the ground floor to other floors, if convenient. In case where power failures are frequent, or where such failure is not tolerated, a battery back-up system should be incorporated**.**A roving vehicle is basically designed to follow a path already predetermined by the user. This path may be as simple as a physical white line on the floor or as complex path marking schemes e.g. embedded lines, magnetic markers and laser guide markers. In orderto detect these specificmarkers, various sensing schemes can be employed. These schemes may vary from simple low-cost line sensing circuit to expansive vision systems. The choice of these schemes would be dependent upon the sensing accuracy and flexibility required. From the industrial point of view, roving vehicle has been implemented in semi to fully autonomous plants. In this environment, these vehicle functions as materials carrier to deliver products from one manufacturing point to another where rail, conveyor and gantry solutions are not possible. Apart from line followingcapabilities, these roving vehicles should also have the capability to navigate junctions and decide on which junction to turn and which junction ignore. This would require the roving vehicle to have 90° turn and also junction counting capabilities. To add on to the complexity of the problem, sensor positioning also plays a role in optimizing the roving vehicle performance for the tasks mentioned earlier.

II. METHODOLOGY & WORKING

The electronic guide stick is a monolithic integrated circuit designed for metallic body detection by sensing variations in high frequency. The output signal level is altered by an approaching metallic object. The output signal is determined by supply current changes. Independent of the supply voltage, this current is high or low, depending on the proximity of a metallic object.

At the edge of the stick is an LDR which senses the metal wire path and send signals to the Photodiode. In return the circuit triggers a photodiode which then sends the signal to a comparator circuit and hence it activates the buzzer.

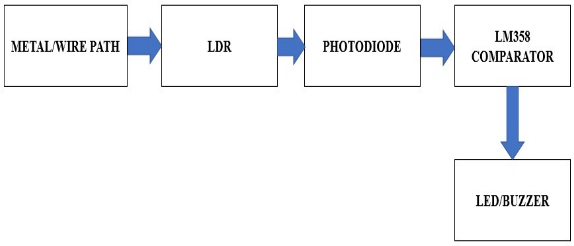

Fig.1. Block Diagram of The Electronic Guide Stick

The roving vehicle is made in a vero board of which two independently working engines propel two back wheels. The two wheels are monitored by Motor Driver and controlled by Dc Motors. The IR Sensors helps in detecting the wire guided path and NOT Gate sends the signal to the Motor Driver to either start or stop the DC Motors. A smaller fore wheel conduces to all directions as the robot requires. The undercarriage is fitted with a sensor module detecting a black line. Another two front sensors detect obstacles in the way.

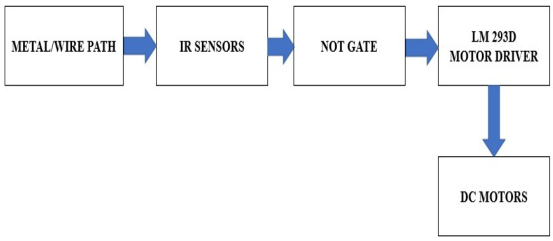

Fig.2. Block Diagram of The Roving Vehicle.

III. RESULTS & FINAL OUTCOME

A black guideline and obstacles are detected by a set of reflective optical sensors. Sensors consist of an emitting light source and detector. Sensor locates existing barriers (object or surface) by using areflective IR beam reflected by the barrier.

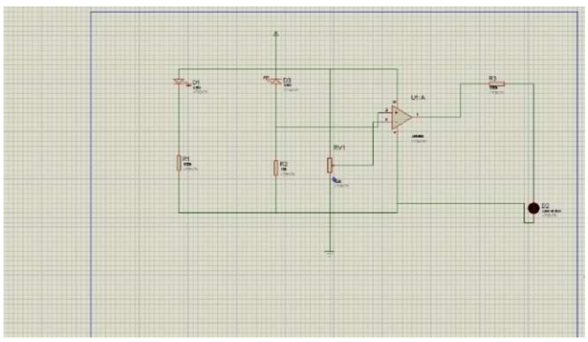

Fig.3. Proteus Simulation of An IR Sensor Circuit for Guide Stick

The block diagram of a roving vehicle(shown in Fig. 2) behaves as we had proposed. It can follow a marked guideline with a speed of 0.28 ms^{-1}. It can avoid collisions while scanning oncoming barriers. The vehicle can be controlled with a remote IR control. When it reaches an end of a line, it simply reverses on its way. In the case where guiding line is split the robot can chose a straighter way (the principle is similar to a tram track). The vehicle can follow any black line wide at least 10 mm.

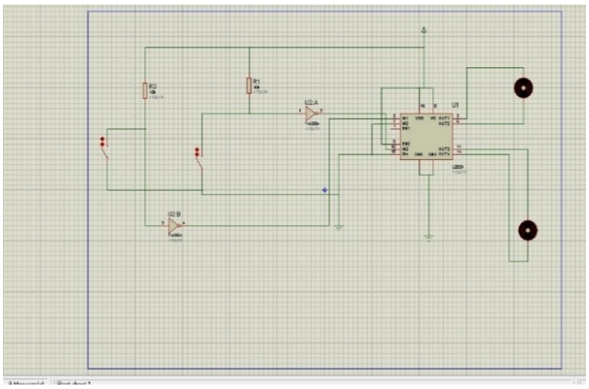

Fig.4. Proteus Simulation of An IR Sensor Circuit for Roving Vehicle

IV. CONCLUSION

Blind and visually impaired people need some aid to interact with their environment with more security, so implementation of this guide-stick will make their mobility easy and safe.The proposed system is economical and efficient.The advantage of the system lies in the fact that it can prove to be very low-cost solution to millions of blind people worldwide. The objectivewas to design a low-cost circuit to provide easy mobility to the blind.

In this paper we had reported, implemented and embedded a Guide Stick & Roving Vehicle using two IR sensor circuits together for blind people. The simulation was done in Proteus for verification and the hardware model was made accordingly.

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