ISSN (Online) 2394-6849

International Journal of Engineering Research in ElectronICand CommunICation Engineering (IJERECE) Vol 3, Issue 6, June 2016

# Robotic Illumination System: A Simplified Approach

[1] Madhurya K [2] Vikas C.M [3] Prof. Ananda M
Dept. of Electronics and Communication
PESIT Bangalore South Campus, Bangalore Bangalore, India

**Abstract: - Border intrusions and trespassing has been a major security issue from a long time. The intruders entering may be a menace to the country. The soldiers or the militants may not be able to keep a keen eye on the trespassers at the borders due to various reasons. In order to detect intrusions at the borders and prevent any possible detrimental activity due to trespassing, we have presented a unique idea. The proposed Robotic Illumination System consists of a light source, an ultrasonic sensor, servo motors and an arduino development kit. The arduino controls the motion of the light source by controlling the servomotors by utilizing the data provided by ultrasonic sensor in order to detect and track the obstacles in the scanning area. Our system which is simple and cost effective, efficiently detects and tracks the obstacle present in the scanning region consistently by illuminating.**

***Index Term*** **- Arduino UNO, Obstacle detection, Obstacle tracking, Servo motor, Ultrasonic sensor**

## I. INTRODUCTION

One of the main security issues pertaining to every country is illegal trespassing the borders. Trespassing border is a very serious offence as they might cause harm to citizen of the respective country. This leads to chaos and fear among the citizens of the country. The soldiers at the border guard the country against illegal trespassing day and night over different weather conditions. It may so happen that due to extreme conditions the soldiers might not be able to keep a keen eye which may lead to trespassing. In order to make the soldiers' work easy and to prevent trespassing which is the most important security aspect this system is designed.

The proposed system can also be used where automatic light illumination and tracking is necessary, like to illuminate and track the speaker or the artist on the stage and the actor during the film shoot.
Our efforts are basically to detect and illuminate a human or an object intruding the area under query. The solution includes the usage of an ultrasonic sensor, a microcontroller (Arduino UNO), servomotors and a lamp for illumination. This edge mounted automatic robotic illumination module tracks the person/obstacle with the aid of HCSR04 ultrasonic sensor.

Ultrasonic sensor is used to evaluate the distance of an obstacle in the field of scan by processing the echoes of ultrasonic sound waves. The range of measurement is 2cm-400cm with a gross error of 3 cm. The features like compact size, higher range and easy usability makes it a handy sensor for mapping and distance measurement. The module can easily be interfaced to Arduino UNO. The sensor has four different pins i.e. supply, ground, trigger and echo pins. A Servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration.

The flow of the paper is as follows, the system description and implementation is described in second section. It also consists of flowchart and interfacing diagram. The next section is results and discussion, which describes the experiments and its results.

## II. SYSTEM CONSTRUCTION AND IMPLEMENTATION

The physical construction of the system is as follows, on a metal base a servo motor (say S1) is fixed, to which ultrasonic sensor is mounted. The servo motor S1, takes care of the horizontal motion of the ultrasonic sensor. To the same metal base a metal rod is mounted to which second servo motor, S2 is fixed. The third servo motor, S3 is mounted to S2 with the help of a support. A lamp is attached to S3, whose horizontal motion is controlled by S2 and vertical motion by S3. Fig.1 describes the physical construction of the system proposed.

ISSN (Online) 2394-6849

International Journal of Engineering Research in ElectronICand CommunICation Engineering (IJERECE) Vol 3, Issue 6, June 2016

All the peripherals are connected to Arduino UNO, which is the heart of the system. A relay circuit is used in order to control the operation of lamp. The ultrasonic sensor transmits an ultrasonic wave and produces an output pulse that corresponds to the time required for the burst echo to return to the sensor. By measuring the echo pulse width, the distance to target can easily be calculated. To begin the measurement process, the ultrasonic sensor must detect and receive a pulse of 5V for 10us which will further initiate the sensor to produce 8 cycles of ultrasonic burst at around 4Khz and wait until the burst is reflected back. The echo pin is set to high (5V), when the sensor detects the ultrasonic waves from the receiver and the delay for a period is in accordance with the distance. The width of the echo signal is measured to obtain the distance. The working of ultrasonic sensor is shown in Fig.2. The trigger and echo signals of ultrasonic sensor is shown if Fig.3.

- Time = Width of Echo pulse, in us (micro second)
- Distance in centimeters = Time / 58
- Distance in inches = Time / 148
- Or you can utilize the speed of sound, which is 340m/s.

***Fig.1. System physical construction***

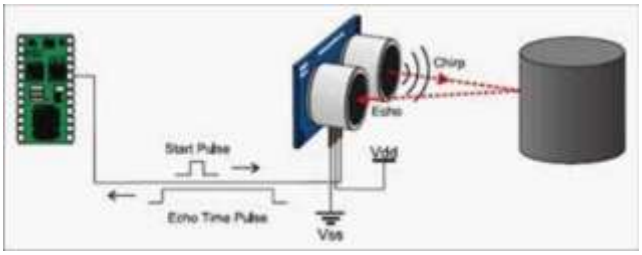


***Fig.2. Working of Ultrasonic sensor***

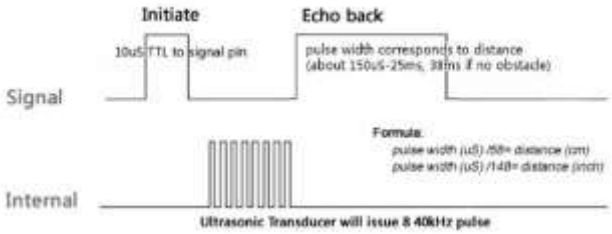


***Fig.3. Trigger and echo signal of Ultrasonic sensor***

The first step is to find the distance of static objects in the scanning area which we refer to as pre-scan phase. This is done in order to obtain a threshold within which the obstacle has to be detected and tracked. This distance from the sensor over a 180 degree sweep is the scanning area.
Once we obtain the threshold distance, the ultrasonic sensor scans the query area from one side to other. If any object is detected within the scanning region i.e. within the threshold distance, then the system locks the target and tracks it continuously, till the obstacle is in the scanning region. When the obstacle is locked, the horizontal angle is obtained by the servo motor S1. Servo motor S2 to an angle same as that of S1. The distance of the object from the sensor is used to calculate the angle by which servo motor S3 is moved in order to illuminate the object.

If the object is moving then the system tracks it by incrementing or decrementing by 5 degrees from the current position of the servo motor in the direction of the movement of the obstacle, else the ultrasonic sensor keeps scanning the area for the obstacle to enter the scanning area. Hence, the three servo motors are used to detect and track the obstacle as explained. Fig.4 is the flowchart of the implementation of the proposed system.

ISSN (Online) 2394-6849

International Journal of Engineering Research in ElectronICand CommunICation Engineering (IJERECE) Vol 3, Issue 6, June 2016

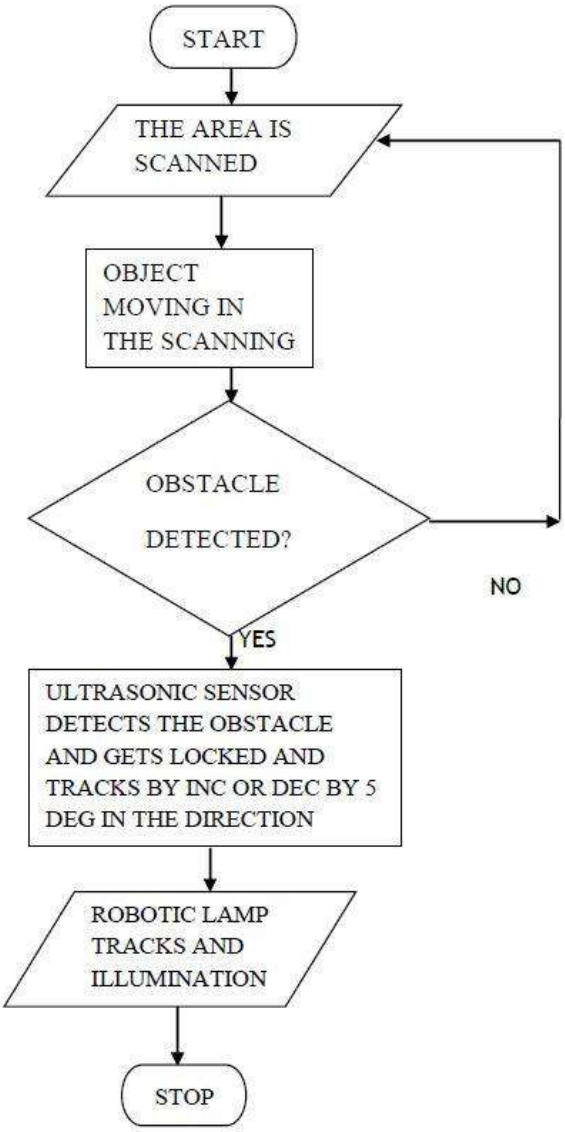


*Fig.4. System flowchart*

The interfacing of peripherals to Arduino UNO is shown in Fig.5. The ultrasonic sensor is connected to the pin 8 and pin 9 of the Arduino UNO. Trigger pulse is pin 9 and echo pulse is pin 8. The relay circuit LM317PSU is connected to pin 2. Servo motors S1, S2 and S3 are connected to pins 6, 10 and 11 respectively. Pin 13 is the common ground.

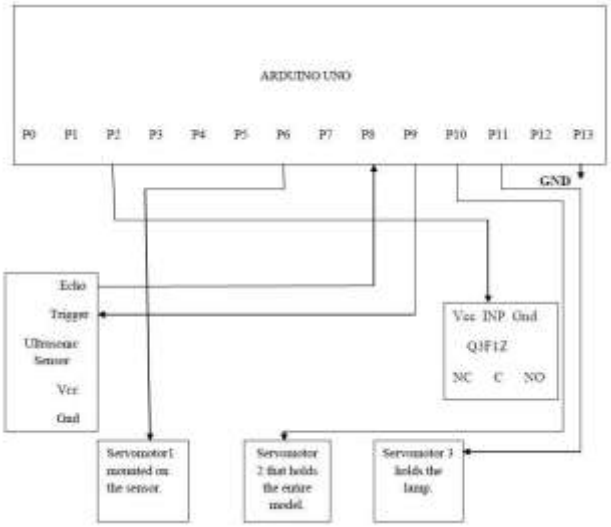


*Fig.5. Interface diagram*

## III. RESULTS AND DISCUSSION

Several experiments were conducted in order to check the performance of the system. It is observed that the system detects any obstacle within the scanning area accurately and illuminates it. The experiments were performed on moving obstacles as well and the proposed system consistently detected and tracked the moving body with a good accuracy.

The motion of servo motors is controlled precisely such that the detection and tracking is accurate. The system is fast, cost effective and also reliable. This automated system prevents the need of any human being to manually illuminate a performer on stage.

The work in [1][2][3] are complex compared to the system proposed by us. [1][2] use PIR sensor and LASER which are costly compared to the ultrasonic sensors. Hence, our system is cost effective, simple and also reliable.

## IV. CONCLUSION

The proposed system which consistently automatically detects and tracks obstacles in the scanning area, can be used at borders to prevent intrusions and trespassing. This system can also be used to automatically illuminate the performer on stage reliably.

## V. ACKNOWLEDGEMENT

We would like to express our sincere gratitude to the college management, Director/Principal of PESIT, BSC to have given us the opportunity for the completion of this project. We convey our thanks to our project guide Prof. Ananda M for providing us the required assistance, encouragement and constant support which helped us a lot. Last but not the least, the project would not have been a success without the support of our parents and friends.

## REFERENCES

[1] S.Sutha, T.Lavanya, "Manifold robotic lamps with an automatic Illumination system", International Journal for technological research in engineering, Volume 2, Issue 8, April 2015

[2] K.Swarupa, M. Narasimha Rao, "Automatic lighting system using multiple robotic lamps", International Jouranl & magazine of engineering, technology, management and research.

[3] Dong-Geol Choi and Byung-Ju Yi Whee-kuk Kim, "Automation of Surgical Illumination System Using Robot and Ultrasonic Sensor", Proceedings of the 2007 IEEE International Conference on Mechatronics and Automation August 5 - 8, 2007, Harbin, China