SONAR RANGING SENSOR FOR SMARTPHONES

Naufa N N

M.Tech,Dept of ECE, College of Engineering,Trivandrum(CET),Kerala

ABSTRACT- We live in a three dimensional world. However, the smart phones that we use every day are incapable of sensing depth, without the use of custom hardware. By creating new depth sensors, we can provide developers with the tools that they need to create immersive mobile applications that take advantage of the 3D nature of our world. In this paper, we propose a new sonar sensor for smart phones. This sonar sensor does not require any additional hardware, and utilizes the phone's microphone and rear speaker. The sonar sensor calculates distances by measuring the elapsed time between the initial pulse and its reflection. We evaluate the accuracy of the sonar sensor by using it to measure the distance from the phone to an object. We found that we were able to measure the distances of objects accurately with an error bound of 12 centimeters

Keywords: *sonar sensor,accuracy,reflection*

INTRODUCTION

Sensors on mobile devices have allowed developers to create innovative mobile applications. For example, the use of GPS localization allows developers to create applications that tailor their content based on the user's location. Other sensors such as the proximity sensor help to improve the user's experience by disabling the touch screen when it detects that the user has placed the phone next to his or her ear. This prevents buttons from accidentally being pressed during a phone call. Since the release of Android 1.5, Google has added application program interface (API) support for eight new sensors. These sensors include: ambient temperature sensors, ambient pressure sensors, humidity sensors, gravity sensors, linear acceleration sensors and gyroscopic sensors.

Developing new and innovative sensors for smart phones will help open the field to new possibilities and fuel innovation. In particular, developing sensors that allow smart phones to perceive depth is key. Google's Advanced Technology and Projects Team share this vision. Engineers at NASA have also partnered with the Google team to attach these phones to robots that will be sent to the international space station.

The sonar sensor was evaluated using three metrics: accuracy, robustness, and real-time performance. The accuracy of the sonar sensor was evaluated by comparing the distances reported by our sensor with known distances. The sensor accurately measured distances within 12 centimeters. The robustness of the sensor was evaluated by comparing the sensor's accuracy under different noise and reverberation conditions in different environments. Finally, the sensor's real time performance was evaluated by measuring the time that it takes to process a signal and return a measurement when different optimizations are applied. By using a collection of optimizations we were able to reduce the processing time from 27 seconds to under two seconds. In-air sonar has been extensively studied in the literature and supports a vast array of sensing capabilities beyond simply ranging. State of the art systems can determine the 3D positions of objects and can even ascertain properties of these objects. However, these techniques cannot simply be ported to smart phones.

OVERVIEW

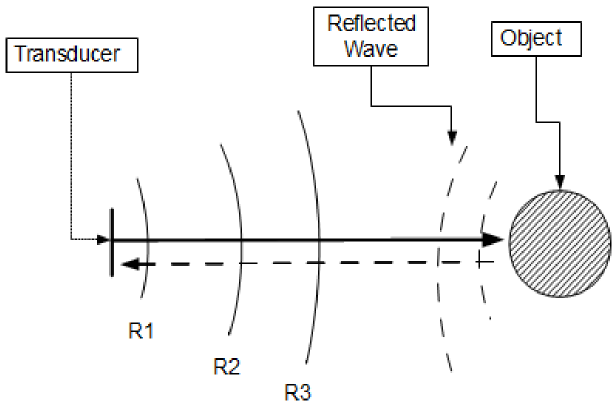

Fig: An overview of the process that the sonar system uses to calculate the distance from the system to an object.

The sonar system generates a pulse. This pulse travels through the air until it encounters an object. The pulse generated is a voice signal, therefore it is converted into pressure waves by using transducer. Once the pulse encounters an object, it is reflected by the object. These reflected waves then travel back to the system which records the reflected pulse. The time difference between the initial pulse and the reflected pulse is used to calculate the distance to the object.

Since the speed of sound in air is known, the distance to an object can be calculated by multiplying the time difference between the initial pulse and the reflected pulse by the speed of sound, and dividing the result by two. We need to divide by two because the time difference between the reflected pulse and the initial pulse accounts for the time that it takes the wave to travel from the phone to the object and back.

WORKING

In this paper we are discussing about software based sonar ranging sensor for smart phone. The sonar ranging sensor is to sense the distance between the searching object under the sea and user's boat. In this project, we use two boat modules.

Boat module-I

In Boat Module I,ARM Microcontroller is used. It is supplied with +5 V Power supply. An ultrasonic sensor is connected to the ARM which can emits ultrasonic waves by using its trigger pin, when a trigger pulse is applied. These ultrasonic waves hit an obstacle and reflected back to the echo pin of the ultrasonic sensor. Thus the ultrasonic sensor calculates distances by measuring the elapsed time between the initial pulse and its reflection. The calculation of distance can be determined can be shown by using an mobile app called 'Blue Term app' in the Smartphone.The value is shown in 'cm ' range and this value is sent to the smart phone by the blue tooth module connected to the ARM.LCD is used for displaying any type of alert/warning when an obstacle is detected.Zigbee is also connected to the ARM and it is used for long data transmission.ie,When an obstacle is detected,Zigbee sends this data to the boat module 2 by using Zigbee of the Boat module 2.

Boat Module II

In Boat module II,we use PIC Microcontroller. It is also supplied with +5v.The data sent by the Zigbee from the boat module I is received by the boat module II.It is then processed by the PIC microcontroller with the help of the program used by the PIC.If any obstacle is detected and the distance from the obstacle is displayed by an LCD in the boat module 2.APR is used for storing the voice of any type of warnings etc…and at the time when an obstacle is detected,APR produces sound with the heip of Speaker.APR has the playback capability of 40-60 seconds.

ADVANTAGES

- Sonar sensor does not require any additional hardware
- It can automatically senses the object
- More secure
- High speed
- Low execution time
- More accurate
- High robustness
- Good efficiency

DISADVANTAGES

- Reverberation may affects the accuracy of sonar systems
- Speed of sound is temperature dependant

CONCLUSION

The proposed sonar sensor is comprised of three components: a signal generation component, a signal capture component and a signal processing component. Designing a sonar system for smart phones presented two unique challenges: Concurrently managing the buffers and achieving real time performance. We addressed the concurrency problem by starting the recording before transmitting the pulse. This allowed us to capture the pulse along with its reflected pulses. Doing this allowed us to determine the index of the pulse and reflections by filtering the signal. Finally,evaluated our sonar sensor using three metrics: accuracy, robustness, and efficiency.It was found that the system was able to accurately measure distances within 30 meters. Evaluated the robustness of the sensor by using it to measure distances in environments with different levels of reverberation.It has been concluded that the system works well in environments that have low reverberation such as outdoor environments and large rooms but does not work well in areas that have high reverberation such as small rooms

REFERENCES

[1] "Introducing project tango," https://www.google.com/atap/projecttango/ #project, accessed: 2014-08-11.

[2] J. Nord, K. Synnes, and P. Parnes, "An architecture for location aware applications," in System Sciences, 2002. HICSS. Proceedings of the 35th Annual Hawaii International Conference on. IEEE, 2002, pp. 3805–3810.

[3] "Nasa sending google's project tango smartphone to space to improve flying robots," http://www.theverge.com/2014/4/19/5629254/nasa-google-partnership-puts-tango-smartphone-on-spheres-robots, accessed: 2014-08-11.

[4] N. D. Lane, E. Miluzzo, H. Lu, D. Peebles, T. Choudhury, and A. T. Campbell, "A survey of mobile phone sensing," Communications Magazine, IEEE, vol. 48, no. 9, pp. 140–150, 2010.

[5] "Sensors Overview," http://developer.android.com/guide/topics/sensors/ sensors overview.html, 2013, [Online; accessed 22-November-2013].