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A PATH FOR HORIZING YOUR INNOVATIVE WORK

ULTRASOUND GESTURE RECOGNITION BY REAL-TIME DISTANCE MONITORING

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Abstract- The aim of this paper is to present a smart system that detects the hand gestured motions using the principal of ultrasonic distance measurement. Ultrasonic sound waves are transmitted by a ultrasound trans-receiver module and are reflected from a any object within its specified range. The reflected waves are then received and detected by a ultrasound module. This module measures a time lag (i.e. the time difference) between the sent pulse and received echo. This time interval is directly proportional to the distance between the module and the object. The gesture recognition is done by collecting these distance samples at regular time interval by a digital processor or microcontroller. These samples (at least two) are then compared with each other in order to identify the motion of object. This analysis can be done by simple subtraction of two consecutive samples. If the subtraction result is found non-zero negative then motion of the object is towards the ultrasound sensor module, else if it is found that the subtraction result is found to be non-zero positive then object is moving away from the ultrasound sensor module.

Keywords: Gesture Recognition, Ultrasound sensor module

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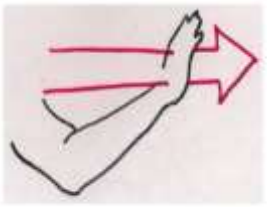
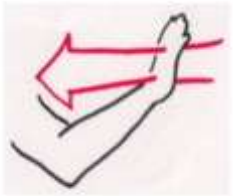
INTRODUCTION

Our current research work spans only two dynamic and one static (default) gesture. For the sake of simplicity we have termed these gestures as “Push”, “Pull” and “Pause”.



Push



Pull

Ultrasound module is used to continuously monitor the motion of the object (i.e. hand). When there is no object found within the specified range of the module, these samples are ignored and this condition is considered as ideal state (i.e. No gesture is given). As soon as any object is found within the range of ultrasound module the distance samples are then processed by the pre-defined algorithm which compares each sample with its previous sample and looks after the difference calculated by means of subtraction.

By analyzing this result one of the following three gesture is then issued to the system output.

Case 1) When subtraction between two consecutive samples (i.e. distance readings collected from ultrasound module) is found negative, then it is referred as “PUSH” i.e. hand is moving towards the sensor module.

Case 2) When subtraction between two consecutive samples (i.e. distance readings collected from ultrasound module) is found positive, then it is referred as “PULL” i.e. hand is moving away from the sensor module.

Case 3) Similarly when subtraction result is found to be zero or very close to zero then this gives rise to possibility of third gesture, which is termed as “Pause” i.e. hand is not moving at all.

As far as this project research is concerned, this third gesture possibility is taken as default action performed by user like “Halt”.

Once the gesture performed by the user by monitoring his/her hand’s motion is correctly recognized, then this result with or without the combined results obtained from other sensors can be utilized to perform any software or hardware action intended by the user. This gesture information can also be used to trigger any hardware or software event or interrupt depending on the applications requirements.

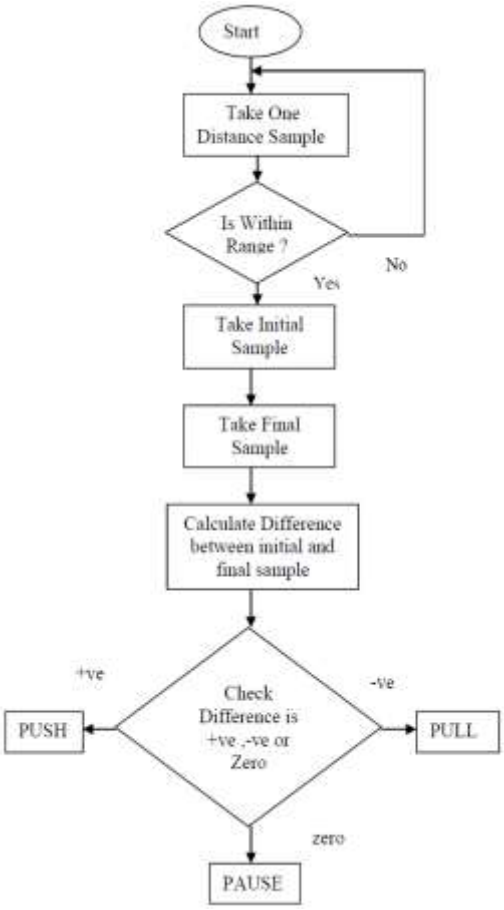


Fig. Flowchart for Ultrasound Gesture Recognition Algorithm.

ALGORITHM:

STEP 1): Start the program by declaring all the variables and functional blocks used in program.

STEP 2): Take a distance reading from ultrasound sensor.

STEP 3): Check whether the object is within the specified range or not. If it is then move to STEP 4, otherwise jump to STEP 2.

STEP 4): Take initial sample and save it in an unsigned variable.

STEP 5): After some delay take final sample and save it in an unsigned variable.

STEP 6): Now calculate the difference between initial and final sample and save it in a signed variable.

STEP 7): Check whether the differentiation result is +ve, -ve or zero (close to zero) and issue the corresponding gesture.

APPLICATIONS:

Ultrasound Gesture Recognition or similar ultrasound based technology might be implemented in following fields in near future.

1) Immersive Gamming Technology
2) Sign Language Interpretation
3) Alternative Computer and Smartphone interface
4) Contactless Remote controls *
5) Home Appliance control
6) Wildlife Photography
7) Peripheral Presence sensing

ADVANTAGES:

The gesture recognition technology being used nowadays is based on camera and image processing technologies. But it has its own limitations, i.e. improper light conditions can affect the gesture recognition. Also such applications requires more processing power which leads to a costly gesture recognition system.

But, using this Ultrasound Gesture Recognition technology all these limitations can be overcome, since its working is totally independent of external light conditions.

LIMITATIONS:

Being a technology which is still under development, there is no special ultrasound sensor that has been designed for gesture recognition. So in order for accurate gesture recognition multiple sensors are required covering different physical dimensions of application. Thus it requires more space and hardware.

Also using this technology into smart-phones and tablets can produce ultrasonic noise in environment. This noise can interfere in working of other ultrasound based devices operating in the same ultrasound spectrum.

RESULT AND CONCLUSION:

The gesture recognition using ultrasound waves is found to be accurate and reliable. The methodology for testing is comprised of movement of single hand motion monitoring made in one dimension. When there is a requirement of more than three gestures then

multiple sensors can be multiplexed (as allowed by the application) in order to improve gesture recognition accuracy.

The detection did not take into account where gesture is made at range which is out of ultrasound modules coverage area. The noise in human audible range did not affect the detection.

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