

MILITARY RADAR SYSTEM WITH BUZZAR ALERT USING IOT

A Project Report Phase – II

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in Electronics and Communication Engineering

by

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**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Dandu Shashank Sri Sai Varma (39130102) Peccheti Praveen Kumar (39130345) who carried out the project entitled "**MILITARY RADAR SYSTEM WITH BUZZAR ALERT USING IOT**" under my supervision from November 2022 to April 2023.

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DECLARATION

We Dandu Shashank Sri Sai Varma (39130102) Peccheti Praveen Kumar (39130345) here by declare that the Project Report entitled “Military Radar System Using IOT with Buzzer Alert” done by us under the guidance of Dr.K.SriLatha,M.E,Ph.D., Associate Professor, Department of Electronics and Communication Engineering submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and Communication Engineering.

DATE: 20-04-2023

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ABSTRACT

This radars have become the “eyes” of electronic devices and the use of radar has become increasingly popular in various fields of study. At the same time, these devices can also be used to assist people in all the fields the life. Ultrasonic radars can accomplish distance measurements by measuring the time delay between the emission of the ultrasonic signal and receipt of the echo signal. Microcontrollers can be connected to perform computations or control timers in these devices. The detection of the distance between the objects (targets) poses a challenge on the temporal resolution of the detector. The correct calibration of these radars is imperative given the fact that the safety of the user depends on the sensor system.

This project is the use of Ultrasonic Sensor by connecting to the Arduino UNO R3 board and the signal from the sensor further provided to the screen formed on the laptop to measure the presence of any obstacle in front of the sensor as well as determine the distance, range, and angle at which the obstacle is detected by the sensor. In this project ultrasound sensor worked as a radar. The use of the Arduino software to design a radar system because Arduino has more advantages

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CHAPTER 1

INTRODUCTION

An IOT is everything produces sound wave just by existence and effect flow of air around them with their natural frequency. These frequencies are beyond hearing range of humans. Wave of frequency range of 20000hz and thereabouts are called ultra-sonic wave and these waves can be detected by an ultrasonic sensor which helps us to get various knowledge. An Ultrasonic detector usually has a transducer which convert sound energy into electrical energy and electrical energy into soundenergy. They are used for measuring object position and orientation, collision avoidance system, surveillance system etc.

Ultrasonic technology provide relief from problem such as linear measurement problem, as it allows user to get non-contact measurements in this way distance between object and its speed etc can easily measured. Speed of travel of sound wave depends upon square root of ratio between medium density and stiffness. Also, property of speed of sound can also be changed by natural environment condition like temperature. So basically, an ultrasonic sensor sends ultrasonic waves which travels in air and gets reflected after striking any object. By studying the property of reflected wave can get knowledge about objects distance, position, speed etc. A processing software and an Arduino software is used with hardware system for detection of objects various parameters

One of the most common application of ultra-sonic sensor is range finding. It is also called as sonar which is same as radar in which ultrasonic sound is directed at a particular direction and if there is any object in its path it strikes it and gets reflected back and after calculation time taken to come back we can determine distance of object. in real life this method is used by bats.

The word RADAR is an acronym derived from the words Radio Detection and Ranging. In the United Kingdom it was initially referred to as radio direction finding (RDF) in order to preserve the secrecy of its ranging capability, after whom the basic unit of frequency is named, demonstrated in 1886 that radio waves could be reflected

from metallic objects. In 1903 a German engineer obtained a patent in several countries for a radio wave device capable of detecting ships, but it aroused little enthusiasm because of its very limited range. drew attention to the work of Hertz and proposed in principle what we know today as marine radar. Although radar was used to determine the height of the ionosphere in the mid-1920s, it was not until 1935 that radar pulses were successfully used to detect and measure the range of an aircraft. In the 1930s there was much simultaneous but independent development of radar techniques in Britain, Germany, France and America. Radar first went to sea in a warship in 1937 and by 1939 considerable improvement in performance had been achieved. By 1944 naval radar had made an appearance on merchant ships and from about the end of the war the growth of civil marine radar began.

Progressively it was refined to meet the needs of peacetime navigation and collision avoidance While the civil marine radars of today may, in size, appearance and versatility, differ markedly from their ancestors of the 1940s, the basic data that they offer, namely target range and bearing, are determined by exploiting the same fundamental principles unveiled so long ago). The term 'Radar' is an acronym for radio detection and ranging Radar system arrives in an assortment of sizes and have distinctive performance particulars. Some radars are utilized for aviation authority at air terminals and others are utilized for long range observation and early-cautioning frameworks There are some ways to show radar working data.

There are also some modified radar systems which have advanced technology of handling the systems. These modified systems are used at higher levels to get or extract the helpful or important data Technology has become available that can detect targets on the land, on the sea, in the air and outside the earth's atmosphere. These include aircraft, land vehicles, ships, air breathing and ballistic missiles and others. Radar has also been used to detect targets ranging from buried ordnance to weather systems to being the cruise control and collision avoidance sensor in luxury cars, to measure the distances and rotational speeds of the planetary neighbor's in the solar system.

RADAR system is an object detection or tracking system which uses radio waves to decide or get the range, height, heading, or speed of items or objects. Radar

frameworks or system arrive in an assortment of sizes and have distinctive performance particulars. Some radars are utilized for aviation authority at air terminals and others are utilized for long range observation and earlycautioning frameworks . There are some ways to show radar working data. There are also some modified radar systems which have advance technologyof handling the systems. These modified system are used at higher levels to get or extract the helpful or important data. The proposed system's working principle is linked by the following components which are is ultra-sonic sensor connected to the microcontroller (we have chosen Arduino) digital input and output pins. Then we have servo motor which is also connected to digital output and input pins. The both main components ultra-sonic sensor and servo motor are connected simultaneously, so that when the servo motor rotates from 0 degree to 180 degree from extreme right to extreme left the motor will rotate nearby its axis . We utilize Computer screen to demonstrate the data (distance and angle) through software called "Processing development Environment"

CHAPTER 2

LITERATURE SURVEY

Brown, B. Lee, et.al (2014) proposed a system using a new method using NMF to learn features in CNN is proposed. In the experiments conducted on CIFAR10, NMF shows the feasibility for reconstruction and classification of color images. Furthermore, unlike edge- or curve- shaped features learned by AE and RBM in CNN, the method provides dot- shaped features. These new types of features could be considered as basic building blocks in the lowest level of constructing images. The results demonstrate that NMF is capable of being a supporting tool for CNN in learning features. NMF and nsNMF are capable of being a supporting tool for CNN in learning the features and classifying image data. Though edge- or curve-shaped features have been shown in previous works using AE or RBM, new type of dotshaped features are drawn in the work. the proposed model is applied to one dataset with limited numbers of features. However, there is a room for improving classification performance in future works by applying a better NMF model, such as stacked NMF, to CNN or multi-layer CNN.

G. Yarovoy and P. W. A. Baltus et.al (2014) developed a system on Ultrafast imaging based on plane-wave (PW) has become an intense area of research thanks to its capability of reaching frame rate higher than a thousand of frames per second. Several proposed approaches are based on Ftheier-domain reconstruction. In these techniques, the Ftheier transform of the received echoes is projected to the k-space corresponding to the Ftheier transform of the object function. For one emitted PW, N lines along the kz axis direction are reconstructed in the k-space. We propose in this study a new acquisition scheme which allows acquiring the non-null part of the ultrasound spectrum with finer resolution. We show that this strategy allows obtaining images with slightly better lateral resolution and higher contrast-to-noise ratio (CNR) when compared to other Ftheier-based techniques. In this system, a new ultrasound acquisition scheme based on Ftheier slice imaging is introduced. This technique allows 14 acquiring the non-null part of the ultrasound spectrum with finer lateral resolution

thanks to a dedicated scheme. The quality and improvement of the reconstructed images were investigated through the measurements of spatial resolution and CNR values from numerical simulations and experimental data. In each case, the proposed method yields better results when compared to the others Ftheier-based method.

Rafael E. Carrillo, Adrien Besson, et.al (2015) proposed a system using a new cocludes that Ultrafast imaging based on plane-wave (PW) insonification is an active area of research due to its capability of reaching high frame rates. Several approaches have been proposed either based on either of Ftheier-domain reconstruction or on delay-and-sum (DAS) reconstruction. Using a single PW, these techniques achieve low quality, in terms of resolution and contrast, compared to the classic DAS method with focused beams. To overcome this drawback, compounding of several steered PWs is needed, which currently decreases the high frame rate limit that could be reached by such techniques. Based on a compressed sensing (CS) framework, we propose a new method that allows the reconstruction of high quality ultrasound (US) images from only 1 PW at the expense of augmenting the computational complexity at the reconstruction. In this paper, a novel approach for Ftheier-based beamforming is proposed. Exploiting sparsity of US images in a Sparsity averaging model, it allows to recover high quality images using l1-minimization algorithm. This leads to an increase of the CNR of approximately 2dB compared to all the Ftheierbased and Space-based techniques for 1 insonifications, while keeping the same spatial resolution. It also enables same contrast as classical DAS method with only 5 PWs. However, the price to pay is a higher computational cost during the reconstruction since solving the l1 minimization problem involves an iterative algorithm.

Shun Miao, et.al (2016) developed a Convolutional Neural Network (CNN) regression approach to address the two major limitations of existing intensity-based 2-D/3-D registration technology: 1) slow computation and 2) small capture range. The CNN regressors are then trained for local zones and applied in a hierarchical manner to break down the complex 15 regression task into multiple simpler sub-tasks that can be learned separately. Weight sharing is furthermore employed in the CNN regression model to reduce the memory footprint. The proposed approach has been quantitatively evaluated on 3 potential clinical applications, demonstrating its significant advantage in

providing highly accurate real-time 2-D/3-D registration with a significantly enlarged capture range when compared to intensity-based methods. The results show that PEHL is more accurate and robust than two accelerated intensity-based 2-D/3-D registration methods, Sparse Histogramming MI (SHMI) [9] and Direct Splatting Correlation (DSC), which employ sub-sampled DRR and splatting DRR to quickly compute approximated MI and CC, respectively.

Adrien Besson, Miaomiao Zhang, et.al (2016) designed a system on Ultrafast imaging based on plane-wave (PW)insonification, which is an active area of research due to its capability of reaching high frame rates. The framework takes advantage of both the ability to formulate the imaging inverse problem in the Ftheier domain and the sparsity of US images in a sparsifying domain. We show, by means of simulations, in vitro and in vivo data, that the proposed framework significantly reduces image artifacts, i.e., measurement noise and sidelobes, compared with classical methods, leading to an increase of the image quality. In this paper, a novel framework for Ftheier-based reconstruction of signals obtained with several PW insonifications has been proposed. The framework relies on the ability to pose the Ftheier reconstruction problem as an ill-posed inverse problem and on the sparsity of the US images in an analysis domain. The reconstruction is achieved by solving an l1-minimization problem.

Adrien Besson, Rafael, et.al (2016) described two applications of the framework namely the sparse inversion of the beamforming problem and the compressed beamforming in which the framework is combined with compressed sensing. Based on numerical simulations and experimental studies, we show the advantage of the proposed methods in terms of image quality compared to classical methods. Two main applications follow on from this formulation. First it enables to increase the image quality by removing 16 measurement artifacts induced by the gridding operation. Secondly, it is suitable to the CS framework and enables the reconstruction of high quality images from undersampled raw data acquired using only a few transducers.

Yang Zhang, Yuexin Guo, et.al (2016) proposed new that achieves high contrast and reduces the axial ghost artifact with only three transmissions for ultrafast

imaging. A new coherence-based factor was derived. The raw data from the PW and the spherical wave (SW) transmissions were compounded based on the factor, with the consideration of their respective coherence and interrelationship, to suppress the side lobes and reduce the axial artifact. Field II simulations show that the proposed method greatly reduced the axial artifact by 20 dB~35 dB compared with coherent plane wave compounding (CPW) and suppressed side lobes by 15 dB~30 dB compared with CPW and sparse SA imaging. we demonstrated the feasibility of the combined PW and SW transmissions with cross coherence based reconstruction in reducing the axial ghost artifact and side lobes in ultrafast imaging. Based on the analysis of axial artifacts and side lobes, proposed method reduce the axial artifacts by 20dB ~ 35 dB, and suppress the side lobes 15dB ~ 30dB. One of the limitations of this work is the weak energy of the SW transmissions by the leftmost and rightmost elements. Since only one element was used to generate a SW, the signal would be affected by the noise in the deep region of interest in the scanned medium. Future work consists in replacing the SW transmissions by diverging wave transmissions.

Li Fangmin, Chen Ke, et.al, (2017) implemented a system using CNN to regress 3DMM shape and texture parameters directly from an input photo and offering a method for generating huge numbers of labeled examples. There are two key points of the paper: one is the training data generation for the model training; the other is the training of 3D reconstruction model. Experimental results and analysis show that this method costs much less time than traditional methods of 3D face modeling, and it is improved for different races on photos with any angles than the existing methods based on deep learning, and the system has better robustness. We propose instead to use a very deep CNN architecture to regress 3DMM parameters directly from input images. We provide a low-cost solution to the problem of obtaining sufficient labeled data to train this network. We show the regressed 3D shapes to be more accurate and robust than those of alternative methods.

Rinan Wei, Fugen Zhou, et.al, (2017) proposed a system using a new a volumetric imaging method from one X-ray projection utilizing convolutional neural network (CNN) is proposed. With the aid of principal component analysis (PCA)-based motion model, a CNN regression model with weighted object function is trained to

estimate the volumetric image accurately. Due to the high parallelization of CNN, the computing efficiency of the proposed method is able to meet the realtime requirement of practical treatment (less than 0.05 seconds). A synthetic test using 4D Extended Cardiac-Torso (XCAT) Phantom is carried out which testify the effectiveness of the method. In this paper, we developed a new volumetric imaging method from single projection based on CNN. PCA motion model is applied as prior information for the estimation of volumetric image. Harshit Gupta, Kyong Hwan Jin, et.al, (2018) In this paper a new image reconstruction method that replaces the projector in a projected gradient descent (PGD) with a convolutional neural network (CNN). We propose a relaxed version of PGD wherein gradient descent enforces measurement consistency, while a CNN recursively projects the solution closer to the space of desired reconstruction images. We show that this algorithm is guaranteed to converge and, under certain conditions, converges to a local minimum of a non-convex inverse problem. Finally, we propose a simple scheme to train the CNN to act like a projector. The proposed framework is generic and can be used to solve a variety of inverse problems including superresolution, deconvolution, accelerated MRI, etc. This can bring more robustness and reliability to the current deep-learning-based techniques.

Zixia Zhou, Yuanyuan Wang, et.al, (2018) designed a novel convolutional neural network (CNN) model for the high spatial–temporal resolution reconstruction of PW ultrasound images is proposed in this paper. Considering the multiangle form of PW data, a multichannel model is introduced to produce balanced training. To combine local and contextual information, the multiscale model is adopted. These two innovations constitute the multichannel and multiscale 18 CNN (MMCNN) model. The advantages of the proposed method were compared with a coherent PW compounding method, a conventional maximum a posteriori-based high spatial resolution reconstruction method, and a 2-D CNN compounding method, and the results verified that the approach is capable of attaining a better temporal resolution and comparable spatial resolution. The proposed approach facilitates the generation of ultrasound images with appropriate spatial and temporal resolution, and the experimental results show its superiority from both subjective and objective perspectives. The proposed method has the potential to be applied to many ultrafast imaging applications.

Jorge Racedo and Matthew W. Urban, et.al, (2019) proposed a method that uses multiple focused ultrasound beams to generate push beams with acoustic radiation force. Applying these push beams generates propagating shear waves. The propagation motion is measured with ultrafast ultrasound imaging. The shear wave motion data are directionally filtered, and a 2-D shear wave velocity (SWV) algorithm is applied to create group velocity maps. This algorithm uses a moving window and a specified patch for performing crosscorrelations of time-domain signals. This study presented a systematic evaluation of a 2-D SWV analysis to determine the effects of varying patch (p) and window (w) sizes has on various image evaluation metrics. It was found that large values for p and w provided reliable measurements of SWV in homogeneous phantoms with low CV. For the inclusion phantoms, different trends for the p and w values for optimizing CNR and bias. This type of study provides a framework for constructing optimal images that could be reconstruction using an iterative or multiscale approach.

Jingfeng Lu, Fabien Millioz, et.al (2019) focused on a convolutional neural network (CNN) architecture for high-quality reconstruction of DW ultrasound images using a small number of transmissions. Experimentally it is demonstrates that the proposed method produces highquality images using only three DWs, yielding an image quality equivalent to the one obtained with standard compounding of 31 DWs in terms of contrast and resolution. A deep-learning-based method is presented in this work for the 19 reconstruction of diverging wave imaging. The proposed approach aims at learning a compounding operator to reconstruct high-quality images using a small number of DWs. The experiments are performed using a large number in vitro and in vivo samples. The experimental results demonstrated the effectiveness of the proposed method, producing an image quality equivalent to the one obtained with standard compounding of 31DWs in terms of contrast and resolution. Anny

Yuniarti, Nanik Suciati, et.al, (2020) implemented several deep-learning models to decode the ShapeNet rendering images that contain 13 model categories to examine the various hyperparameters' impacts on each 3D model category. The experiments showed that the hyper-parameters of the learning rate and epochs set to either 0.001 or 0.0001 and 60-80 epochs significantly outperformed other settings. After

the tuning of the hyper-parameters was thoroughly investigated, this study also incorporated multiple architectures for further validation. Moreover, analysis of the network performance also was performed on the category wise level. Moreover, we observed that regardless of network configuration, some categories (plane, watercraft, car) performed better throughout the study. Therefore, a 3D reconstruction based on image classification can be designed based on the best performing categories.

Dimitris Perdios, Manuel Vonlanthen, et.al, (2020) investigated the applicability of convolutional neural network (CNN)-based image reconstruction, having recently proven its potential in reducing GL artifacts, for reconstructing images from single unfocused acquisitions using uniformly undersampled linear array configurations on receive. The proposed reconstruction method consists of first computing a low-quality estimate from the undersampled single-shot acquisitions using a delay-and-sum (DAS) algorithm, followed by applying a real-time-capable CNN, trained specifically to reduce diffraction artifacts. The proposed approach achieved an image comparable or better to that obtained from conventional DAS beamforming using the full array with uniformly undersampled arrays up to a factor of three, demonstrating a promising potential for sparse array imaging in general. the 20 proposed CNN-based image reconstruction method can increase the image quality achieved from single PW acquisitions using uniformly undersampled linear arrays on receive. Indeed, the overall quality of the restored images is competitive to images reconstructed by a DAS algorithm from single PW acquisitions on the full array up to an undersampling factor of three, demonstrating a high potential in the context of sparse array imaging.

Dimitris Perdios, et.al, (2021) focused an approach relies on single ultrafast acquisitions to reconstruct high-quality frames and on only two consecutive frames to obtain 2-D displacement estimates. To this end, we deployed a convolutional neural network-based image reconstruction method combined with a speckle tracking algorithm based on cross-correlation. This approach is capable of estimating displacements in regions where the presence of side lobe and grating lobe artifacts prevents any displacement estimation with a state-of-the-art technique that relies on conventional delayand-sum beamforming. The approach consists of a CNN trained to restore high-quality images from single unfocused acquisitions and a speckle tracking

algorithm to estimate inter-frame displacements from two consecutive frames only. The proposed approach may therefore unlock the full potential of ultrafast ultrasound, in applications such as ultrasensitive cardiovascular motion and flow analysis or shear-wave elastography.

Shohei Ouchi and Satoshi, et.al, (2021) proposed a novel Transformed Image Domain CNN-CS using multi-channel grouped CNN-based image reconstruction using the Fresnel transform (eFREBAS transform). Experimental results showed that the proposed method was able to predict an artifact-free image better than other methods, especially for a 20- 30% low sampling rate. eFREBAS-CNN enables us to remove most of aliasing artifacts and improves the restoration of the fine structure of images. These results indicate that the application transformed image domain-based CNNCS is effective in upgrading reconstruction performance.

Regev Cohen, et.al, (2021) proposed technique that consider diverging-wave transmission and achieves improved image resolution and contrast compared with standarddelay-and-sumbeamforming while enabling a 21 high frame rate. Incorporating 2-D sparse arrays into the method creates SCOBAS-3D: a sparse beamformer that offers significant element reduction and, thus, allows performing 3-D imaging with the restheces typically available for 2-D setups. To create 2-D thinned arrays, we present a scalable and systematic way to design 2-D fractal sparse arrays. Fractal array design complements the proposed beamforming by allowing us to construct sparse arrays where the majority of receive electronics are discarded. Thus, we reduce the processing rate, cost, and power, facilitating the use of highperformance 3-D US imaging with limited hardware. The proposed framework paves the way for affordable ultrafast US devices that perform high-quality 3- D imaging, as demonstrated using phantom and ex-vivo data.

Jui-Ying Lu, Po-Yang Lee, et.al, (2022) developed a convolutional neural network (CNN) beamformer based on a combination of the GoogLeNet and U-Net architectures to replace the conventional delay-andsum (DAS) algorithm to obtain high-quality images at a high frame rate. RF channel data are used as the inputs for the CNN beamformers. The outputs are in-phase and quadrature data. Simulations and

phantom experiments revealed that the images predicted by the CNN beamformers had higher resolution and contrast than those predicted by conventional single-angle PW imaging with the DAS approach. In in vivo studies, the contrast-to-noise ratios (CNRs) of carotid artery images predicted by the CNN beamformers using three or five PWs as ground truths were approximately 12 dB in the transverse view, considerably higher than the CNR obtained using the DAS beamformer (3.9 dB). Most tissue speckle information was retained in the in vivo images produced by the CNN beamformers. In conclusion, only a single PW at 0° was fired, but the quality of the output image was proximal to that of an image generated using three or five PW angles. The quality–frame rate tradeoff of coherence compounding could be mitigated through the use of the proposed CNN for beamforming.

Luchies A, Van der Schoot, et.al (2020) developed a system that provides a comprehensive review of the current state-of-the-art in deep learning-based approaches for ultrafast ultrasound imaging. The authors discuss various deep learning architectures that have been proposed for ultrafast ultrasound imaging, including convolutional neural networks (CNNs), recurrent neural networks (RNNs), and generative adversarial networks (GANs). The paper also provides a detailed overview of the datasets used for training and validating these deep learning models, as well as the metrics used for evaluating their performance. The authors highlight the potential of these deep learning-based approaches to improve the accuracy and efficiency of ultrasound imaging, particularly in clinical applications such as obstetrics, cardiology, and oncology. The paper concludes with a discussion of future research directions in this area, including the integration of other imaging modalities and the development of more sophisticated deep learning architectures.

2.2 Open problems in Existing System

High tech radar systems are associated with digital signal processing and can extract useful information from very high noise levels. The history of radar (Radio Detection and Ranging) started with experiments by Heinrich Hertz in the late 19th century that showed that radio waves were reflected by metallic objects. This possibility

was International Jthenal of Scientific Research and Engineering suggested in James Clerk Maxwell's seminal work on electromagnetism. However, it was not until the early 20th century that systems able to use these principles were becoming widely available, and it was German inventor Christian Hülsmeyer who first used them to build a simple ship detection device intended to help avoid collisions in fog. Numerous similar systems, which provided directional information to objects over short ranges, were developed over the next two decades. The development of systems able to produce short pulses of radio energy was the key advance that allowed modern radar systems to come into existence.

By timing the pulse on an oscilloscope, the range could be determined and the direction of the antenna revealed the angular location of the targets. The two, combined, produced a "fix", locating the target relative to the antenna. In the year 1934–1939, eight nations developed radar independently, and in great secrecy. These nations were; the United Kingdom, Germany, USSR, Japan, Netherlands, France and Italy. In addition, Britain shared their information with the United States and fthe commonwealthm countries: Australia, Canada, New Zealand, and South Africa. These countries also developed their own radar systems. During the war, Hungary was added to this list .

The term RADAR was coined in 1939 by the United States Signal Corps as it worked on these systems for the US Navy. Progress during the war was rapid and of great importance, probably one of the decisive factors for the victory of the Allies. A key development was the magnetron in the UK , which allowed the creation of relatively small systems with sub-meter resolution. At the end of hostilities, Britain, Germany, the United States, the USSR, and Japan had a wide variety of land and sea-based radars as well as small airborne systems. After the war, radar use was widened to numerous fields including: civil aviation, marine navigation, radar guns for police, meteorology and even medicine. Key developments in the post-war period include the travelling wave tube as a way to produce large quantities of coherent microwaves, the development of signal delay systems that led to phased

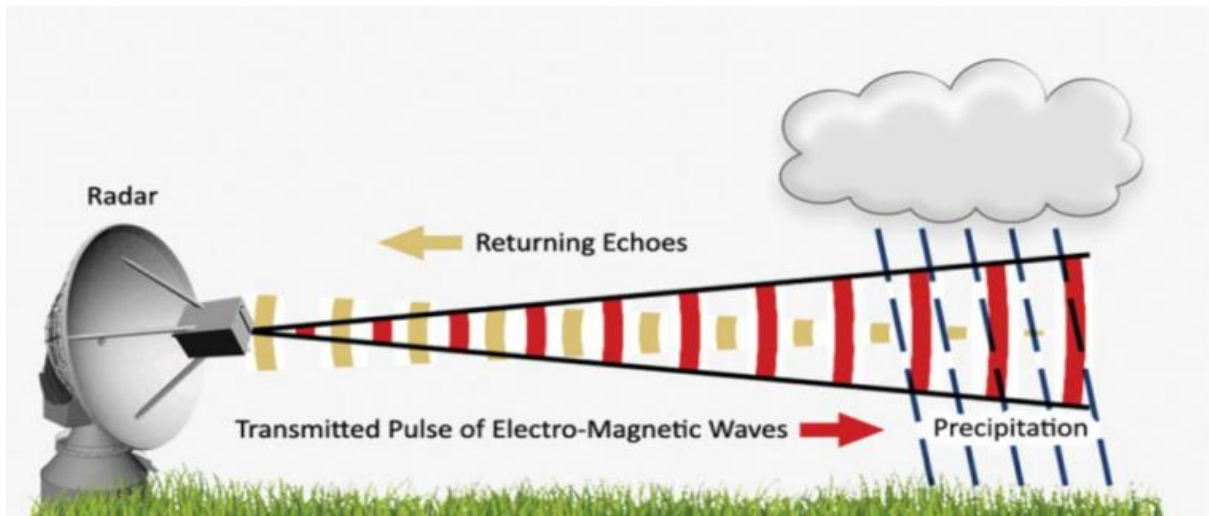


Fig: 2.1 : Existing Radar System Echo Signal Process

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

In the existing system the ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception. An optical sensor has a transmitter and receiver, whereas an ultrasonic sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head. Distance calculation The distance can be calculated with the following formula:

$$\text{Distance } L = 1/2 \times T \times C \quad (3.1)$$

Where L is the distance,

T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance.)

Features shows typical characteristics enabled by the detection system.

- [Transparent object detectable] Since ultrasonic waves can reflect off a glass or liquid surface and return to the sensor head, even transparent targets can be detected.
- [Resistant to mist and dirt] Detection is not affected by accumulation of dust or dirt.
- [Complex shaped objects detectable] Presence detection is stable even for targets such as mesh trays or springs.

The development of the radar technology took place during the World War II in which it was used for detecting the approaching aircraft and then later for many other purposes which finally led to the development of advanced military radars being used these days. Military radars have a highly specialized design to be highly mobile and easily transportable, by air as well as ground. Military radar should be an early warning, altering along with weapon control functions. It is specially designed to be highly mobile and should be such that it can be deployed within minutes.

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices.

3.1 Feasibility Studies/Risk Analysis of the Project

The working of the existing system, after its designing, construction and programming we placed few objects in front of the ultrasonic sensor. As the motor started to rotate, the monitor started to display the output through processing IDE. Hence, when the sensor crossed over the object it showed a red segment with the distance and angle where the object is placed. The first object was placed at the distance of 30.5cm measured through a ruler and the system measured the distance at 32cm. While the second object was placed at a distance of 20 cm and the system measured it as 21cm. Hence the calculated efficiency turned out to be 95%. The figure represents a brief overview of this radar system. Here, as it is shown the controller and Arduino, with the input Ultrasonic sensor and the output is the servo motor which rotates 180 degrees. The microcontroller controls all the operations of this system, from rotation of the motors to the obstacle detection of the ultrasonic and representation of the result on the screen. The figure represents the system's block diagram. Here, it can be seen how the work flow in this radar system. The sensor is going to sense the obstacle and determine the angle of incident and its distance from the radar. The servo motor is constantly rotating to and from, hence making the sensor move. The data obtained is encoded and fed to the processing IDE which represents it on the screen. The results are displayed further in this paper. All these operations are done by Arduino microcontroller from the rotation of the servo, data collection from the sensor, feeding the data to encoder to transferring it to the display.

3.2 Software Requirements Specification Document

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components,

owing to its open source hardware feature. It is basically used in communications and in controlling or operating many devices. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell the board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide. As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception. An optical sensor has a transmitter and receiver, whereas an ultrasonic sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head.

3.3 System Use case

All processing is an open-source computer programming language and integrated development environment (IDE) built for the electronic arts, new media art,

and visual design communities to teach the fundamentals of computer programming in a visual context The Specifications of programming:

- Free to download and open sthece
- Interactive programs with 2D, 3D or PDF output
- OpenGL integration for accelerated 2D and 3D
- For GNU/Linux, Mac OS X, and Windows
- Over 100 libraries extend the core software • Well documented, with many books available

CHAPTER 4

PROPOSED SYSTEM AND ALGORITHM

4.1 Selected Methodology or process model

The working of the proposed system, after its designing, construction and programming a few objects are placed in front of the ultrasonic sensor. As the motor started to rotate, the monitor started to display the output through processing IDE. Hence, when the sensor crossed over the object it showed a red segment with the distance and angle where the object is placed. The first object was placed at the distance of 30.5cm measured through a ruler and the system measured the distance at 32cm. While the second object was placed at a distance of 20 cm and the system measured it as 21cm. Hence the calculated efficiency turned out to be 95%.

The represents a brief overview of this radar system. Here, as it is shown the controller we are using is Arduino, with the input Ultrasonic sensor and the output is the servo motor which rotates 180 degrees. The microcontroller controls all the operations of this system, from rotation of the motors to the obstacle detection of the ultrasonic and representation of the result on the screen. Here, it can be seen how the work flow in this radar system. The sensor is going to sense the obstacle and determine the angle of incident and its distance from the radar. The servo motor is constantly rotating to and fro, hence making the sensor move. The data obtained is encoded and fed to the processing IDE which represents it on the screen. The results are displayed further in this paper. All these operation are done by Arduino microcontroller from the rotation of the servo, data collection from the sensor, feeding the data to encoder to transferring it to the display.

The required hardware components for this project are, Arduino UNO, Ultrasonic Sensor, Servomotors, Buzzer, LEDs, Pushbutton, Connecting Wires, and Bread Board. The microcontroller is connected to one ultrasonic sensor, three servomotors, a buzzer, and LEDs. First, the ultrasonic sensor is mounted on a servo motor to rotate at the desired angle, to create a range for the ultrasonic sensor to sense external objects. The

ultrasonic sensor and servo motor are mounted on a higher platform to detect objects at a higher altitude with ease. A turret is created for firing the missile on the external object. This Turret is mounted on another servomotor where it turns to the angle according to the detected angle of the servo motor of the ultrasonic sensor. The angle of the servomotor and turret must be equal to ensure the accurate firing of the missile. As this is a prototype of a conventional turret, just an elastic band is used for the firing mechanism which is controlled by a servomotor and pushbutton for enabling the firing of the missile. Meanwhile, for a visual warning, the Arduino triggers a signal to the LEDs to light up and for an auditory trigger,

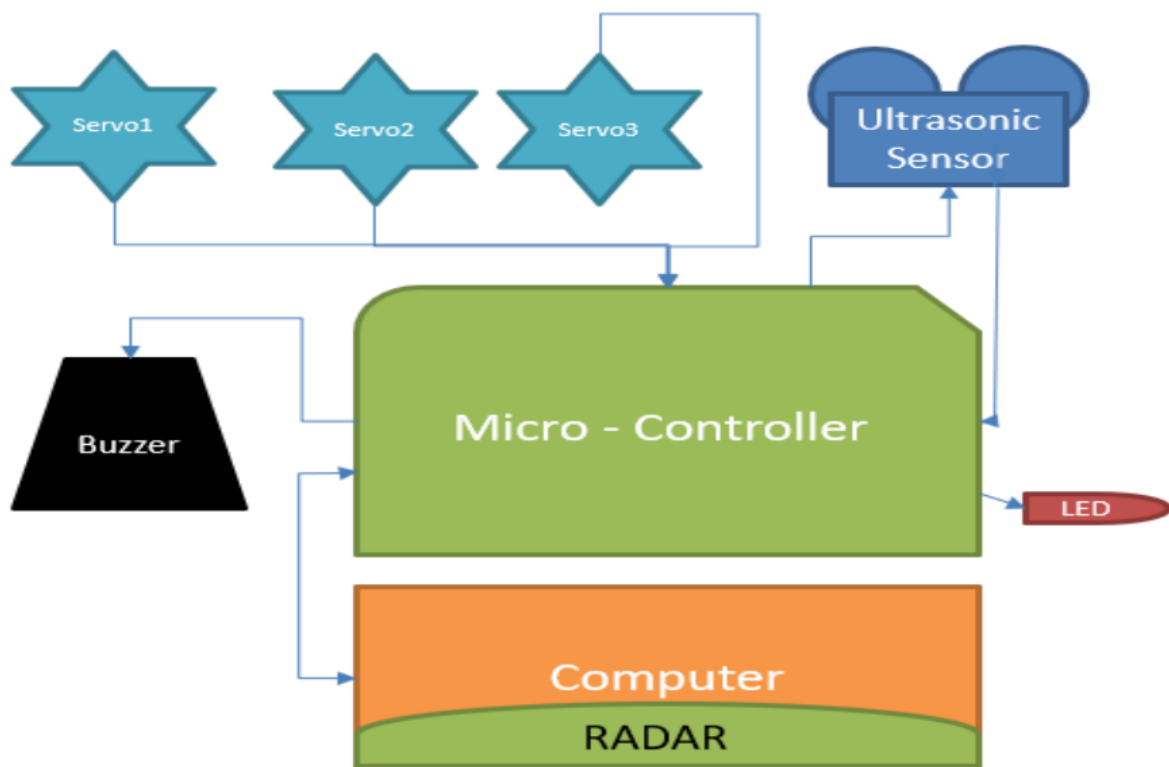


Fig: 4.1: Block Diagram of Proposed Radar System

4.2 Project Management Plan

Produced sound wave by the presence and impact stream of air around them with their normal recurrence. These frequencies are past hearing scope of people. Wave of recurrence scope of 20000 hz and somewhere around there are called supersonic wave and these waves can be distinguished by a ultrasonic sensor which assists us with getting different information. A Ultrasonic finder normally has a transducer which convert sound energy into electrical energy and electrical energy into

sound energy. They are utilized for estimating object position and direction, crash evasion framework, observation framework and so on. Ultrasonic innovation give help from issue like straight estimation issue, as it permits client to get noncontact estimations in this manner distance among object and its speed and so forth can be effectively estimated. Speed of movement of sound wave relies on square foundation of proportion between medium thickness and solidness. Additionally, property of speed of sound can likewise be changed by regular habitat condition like temperature. So fundamentally, a ultrasonic sensor sends ultrasonic waves which goes in air and gets reflected subsequent to striking any item. By concentrating on the property of reflected wave, we can get information about objects distance, position, and speed and so on. A handling programming and an Arduino programming is utilized with equipment framework for discovery of items different boundaries.

One of the most well-known use of supersonic sensor is range finding. It is likewise called as sonar which is same as radar in which ultrasonic sound is aimed at a specific cthese and on the off chance that there is any item in its way it strikes it and gets reflected back and after estimation opportunity taken to arrive back we can decide distance of item. In actuality, this technique is utilized by bats. The figure displayed underneath shows the advancement life pattern of Radar project which includes different step like plan of various parts, their testing, their execution and execution of whole framework and their testing. These means can be specified into following stages The point of this undertaking is to compute the distance position and speed of the article set at some separation from the sensor.

Ultrasonic sensor sends the ultrasonic wave every which way by turning with assistance of servo engine. This wave goes in air and gets reflected back subsequent to striking some item. This wave is again detected by the sensor and its attributes is broke down and result is shown in screen showing boundaries like distance and position of item. Arduino IDE is utilized to compose code and transfer coding in Arduino and assists us with detecting position of servo engine and presenting it on the sequential port alongside the distance of the closest article in its way. The result of sensor is shown with the assistance of handling programming to give last result in show screen. Arduino board conveys a message of +5V to the trig pin of Ultrasonic Sensor

HC-SR04 which sets off the sensor. Then, at that point, it gives rotational activity at the servo engine precisely fitted alongside ultrasonic Sensor HC-SR04 so it can recognize the moving articles and situate inside 180 degrees. The Arduino sends a HIGH heartbeat width of (10 S) on the TRIGGER pin of the sensor to recover a progression of ultrasonic waves that engender through the air until it contacts a hindrance and returns the other way towards the sensor pin ECHO.

The sensor recognizes the width of the beat to ascertain the distance. The sign on pin ECHO the sensor stays at the HIGH situation during transmission, in this manner estimating the term of the full circle of ultrasound and consequently decide the distance. The LCD show shows the determined distance and the point of turn. The signal is an extra part, it rings when there is a location (Tone1 and Tone2) alongside LEDs. The two LEDs alongside the signal decide the field where the article is situated (close or far off).

The radar system is used mostly for mapping and has several uses for protection purposes.

- Application in Air Force: This is used for the identification of items that come in by aeroplane or aircraft devices that have a radar device in it. It is often used for the height measurement calculation.
- Application in Marine: It is also used in ships or in marine applications. The distance of other boats or ships is measured on big ships and can be minimized by not colliding with the aid of this sea accident. It can also be used at ports to see the distance from other vessels and track or monitor the movements of the vessels.
- Application In Meteorology: Wind tracking or monitoring is also done with radar systems. It has become a major climate monitoring equipment. For starters, storms are used to detect tornados.

The basic objective of the design is to ascertain the distance position and speed of the obstacle set at some distance from the sensor. Ultrasonic sensor sends the ultrasonic wave in various ways by rotating with help of servo motors. This wave goes in air and gets reflected back subsequent to striking some object. This wave is again detected by the sensor and its qualities is analyzed and output is shown in screen indicating parameters, for example, distance and position of object. Arduino IDE is

utilized to compose code and transfer coding in Arduino and causes us to detect position or angle of servo motor and it is communicated through the serial port alongside the covered distance of the nearest object in its way. Output of all of this working is shown in the software called processing, it will display the input/output and the range of the object .

Implementations of the sensors are done in such a way that ultra-sonic sensor is attached on top of the servo motor because it have to detect the object and its distance. Arduino (micro-controller) will control the ultra-sonic sensor and servo motor and also powered will be given to both of them through micro-controller .Radar is an electromagnetic system for the detect and determine the locations of objects and determine distance, and ranges. It operates by transmitting a particular type of waveform, a pulse-modulated, and detects the nature of the echo signal. Radar is used to extend the capability of one's senses for observing the environment, especially the sense of vision .An elementary form of radar consists of a transmitting antenna emitting electromagnetic radiation generated by an oscillator of some sort, a receiving antenna, and the receiver. A portion of the transmitted signal is intercepted by a reflecting object (target) and is radiated in all directions.

The receiving antenna collects the returned energy and delivers it to a receiver, where it is processed to detect the presence of the target and to extract its location and relative velocity. The distance to the target is determined by measuring the time taken for the radar signal to travel to the target and back. The direction of the target determined from the direction of arrival of the reflected wavefront. The basic concept of a radar transmitting a signal and receiving a return from a target .An object (normally referred to as a target) is detected by the transmission of a pulse of radio energy and the subsequent reception of a fraction of such energy (the echo) which is reflected by the target in the direction of the transmitter. The phenomenon is analogous to the reflection of sound waves from land formations. If a blast is sounded on a ship's whistle, the energy travels outward and some of it may strike. The energy which is intercepted will be reflected by the cliff. If the reflected energy returns in the direction of the ship, and is of sufficient strength, it will be heard as an audible echo which, in duration and tone, resembles the original blast. In considering the echo principle the following points

can usefully assist in a preliminary understanding of radar detection:

- (a) The echo is never as loud as the original blast.
- (b) The chance of detecting an echoes depends on the loudness and duration of the original blast.
- (c) Short blasts are required if echoes from close targets are not to be drowned by the original blast.
- (d) A sufficiently long interval between blasts is required to allow time for echoes from distant targets to return. While the sound analogy is extremely useful, it must not be pursued too far, as there are a number of ways in which the character and behavior of radio waves differ from those of sound waves. In particular at this stage it is noteworthy that the speed of radio waves is very much higher than that of sound waves.

4.3 Financial report on estimated costing

An **ultrasonic sensor** is a proximity sensor that is used to measure the distance of a target or object. It detects the object by transmitting ultrasonic waves and converts the reflected waves into an electrical signal. These sound waves travel faster than the speed of the sound that humans can hear.



Fig: 4.2 : Ultrasonic sensor

It has two main components: the transmitter & receiver. The transmitter emits the sound using a piezoelectric crystal, and the receiver encounters the sound after it has travelled to and from the target. For the calculation of the object distance, the sensor measures the time taken by the signal to travel between the transmission of the sound by the transmitter to the reflecting back towards the receiver.

The formula for this calculation is,

$$D = \frac{1}{2} T \times C \quad \text{(Equation 4.1)}$$

Where,

- D = distance,
- T = time
- C = speed of sound which is 343 meters/second.

sensors are mostly found in automobile self-parking technology and anti-collision safety systems. Also, used in robotic obstacle detection systems, manufacturing technology, and many more. To know more about the ultrasonic sensor, refer to the Ultra Sonic Sensor

Servo motor is a simple DC motor that can be controlled for specific angular rotation with the help of additional servomechanism. This motor will only rotate as much we want and then stop. The servo motor is a closed-loop mechanism that uses positional feedback to control the speed and position. closed-loop system includes a control circuit, servo motor, shaft, potentiometer, drive gears, amplifier, and either an encoder or resolver.



Fig: 4.3 : Servo Motor

The servo motor is unlike a standard electric motor which starts and stops according to the power input. According to the signal, the servo motor will work.

servo motors are widely used in industrial and robotics applications. They are also commonly seen in remote-controlled toy cars, RC planes, and in the CD or DVD player. seeing hundreds of applications in the daily life that use a servo motor. To know more about the servo motor, refer to the servo motor working principle. In the figure triggering pins of ultrasonic sensor is connected to D8 pin of Arduino, control line of servo motor is connected to D6 pin of Arduino and D7 pin of Arduino is connected to echo pin. VCC pins of servo motor and ultrasonic sensor is connected to 5V pin of Arduino while ground pin of Arduino is connected to ground pin of both servo motor and ultra-sonic sensor.

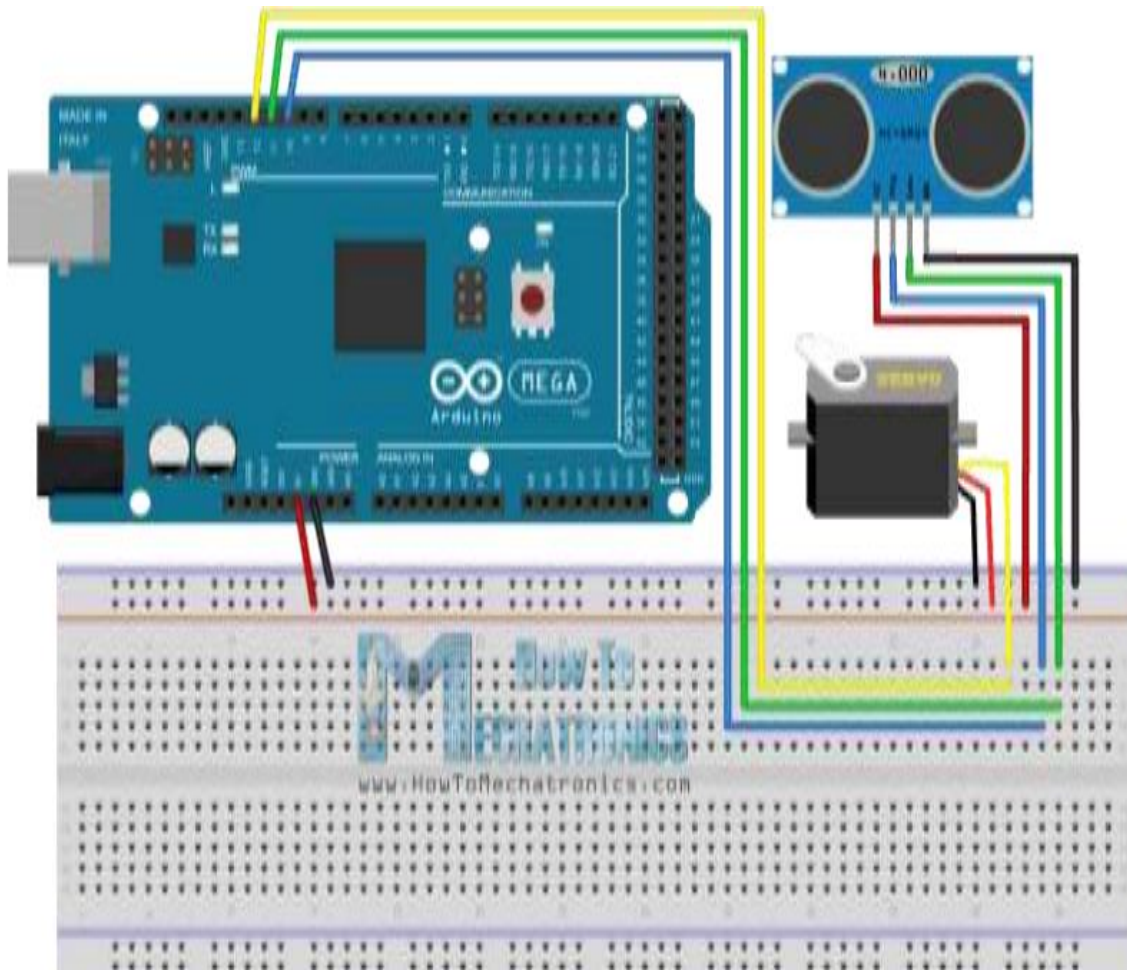


Fig: 4.4 : Circuit Diagram

4.4 Transition/ Software to Operations Plan

All processing is an open-souce computer programming language and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities to teach the fundamentals of computer programming in a visual context. The Specifications of programming:

- Free to download and open sthce
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- OpenGL integration for accelerated 2D and 3D
- For GNU/Linux, Mac OS X, and Windows
- Over 100 libraries extend the core software

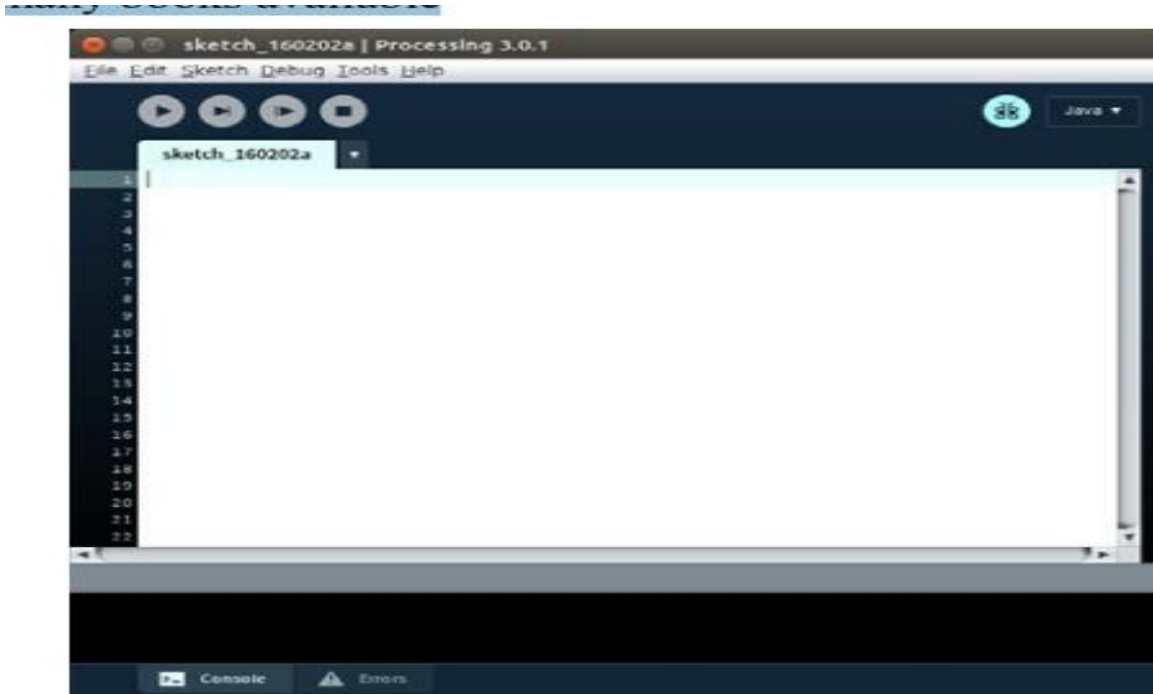


Fig: 4.5: Arduino Software

The radar system is used mostly for mapping and has several uses for protection purposes.

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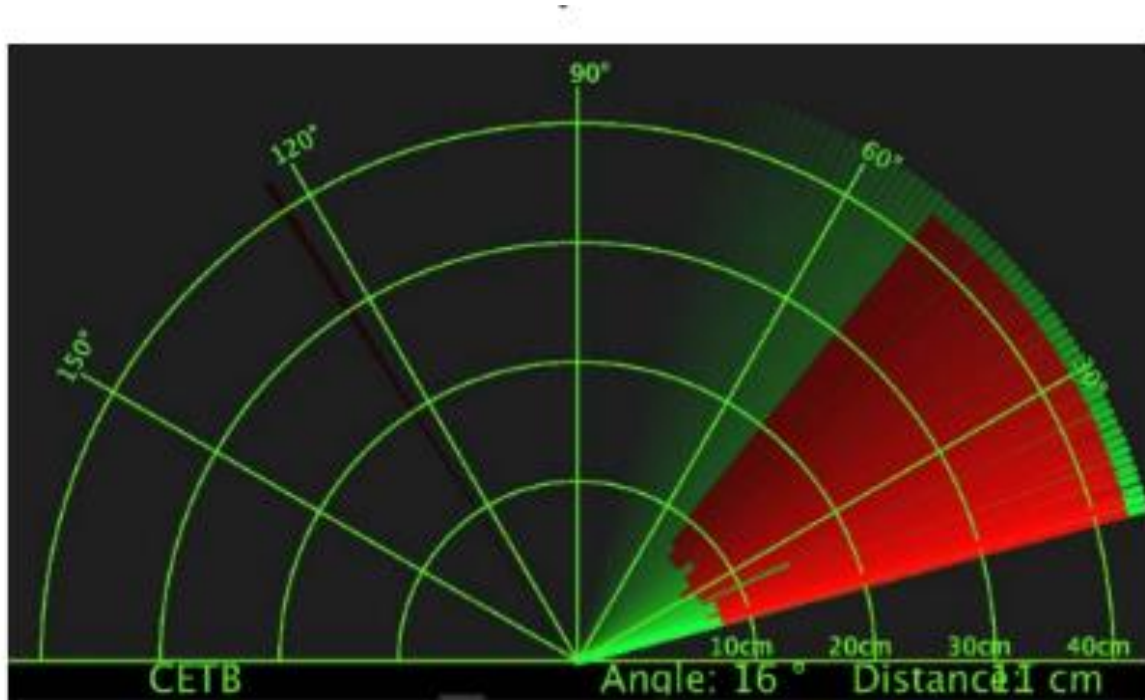


Fig: 4.6 : Graphical Output Result

System Requirements the system requirements, including the operational environment, detection and tracking performance, communication interfaces, and integration with other systems. Develop a detailed radar system design, including the radar architecture, antenna design, transmitter and receiver design, signal processing algorithms, and user interface design.

Hardware Implementation Select and procure the necessary hardware components for the radar system, including antennas, transmitters, receivers, signal

processors, and other electronic components. Assemble and integrate the hardware components according to the system design.

Software Development Develop the software for the radar system, including the signal processing algorithms, user interface, data processing and fusion, and system control. Use appropriate programming languages, tools, and libraries for the development.

Data Acquisition and Processing Implement data acquisition and processing subsystems to collect and analyze radar data, including raw radar returns, detected targets, and tracked targets. Implement data filtering, noise reduction, and target extraction algorithms to improve the radar system's performance.

System Integration and Testing Integrate the hardware and software components of the radar system and conduct thorough testing to ensure the system meets the defined requirements. Conduct functional, performance, and environmental testing to validate the system's performance and reliability.

User Interface Design Design and implement a user interface that allows operators to control and monitor the radar system. The user interface should be intuitive, easy to use, and provide relevant information to the operators for decision-making.

Documentation Create detailed documentation for the radar system, including system design documents, user manuals, maintenance manuals, and other relevant documentation to support system operation, maintenance, and troubleshooting.

Safety and Security Implement appropriate safety and security measures to protect the radar system from unauthorized access, data breaches, and other security risks. Follow established security protocols and guidelines for defense systems.

Verification and Validation Verify and validate the radar system's performance and functionality against the defined requirements and specifications. Conduct thorough testing, analysis, and evaluation to ensure the system meets the expected performance levels.

Training and Deployment Provide training to the operators and maintenance personnel on how to operate, maintain, and troubleshoot the radar system. Deploy the radar system to the designated operational environment and ensure it is ready for operational use.

Maintenance and Support Establish a maintenance and support plan to ensure the radar system's ongoing performance, reliability, and availability. Provide regular maintenance, upgrades, and technical support as needed to keep the system operational and effective. It's important to note that the implementation details for a

defense radar system project may vary depending on the specific requirements, technologies, and regulations in the country or region. It's essential to consult with domain experts, follow established industry standards and best practices, and comply with relevant regulations and guidelines throughout the implementation process.

4.5 Algorithms

Pseudocode for Radar System Algorithm

Data Acquisition

raw_data = acquire_raw_data() # Collect raw data from radar sensors

Signal Processing

processed_data = process_raw_data(raw_data) # Process raw data to extract relevant information

Detection

detected_targets = detect_targets(processed_data) # Detect potential targets from processed data

Tracking

tracked_targets = track_targets(detected_targets) # Track detected targets over time

Classification

classified_targets = classify_targets(tracked_targets) # Classify targets based on their characteristics

Fusion

fused_targets = fuse_targets(classified_targets) # Integrate information from multiple sensors

Decision Making

```
decisions = make_decisions(fused_targets) # Make decisions based on target
information
```

```
# Visualization
```

```
display_data = prepare_display_data(fused_targets) # Prepare data for visualization
display(display_data) # Present data on radar display or graphical user interface
```

```
# System Control
```

```
control_parameters = optimize_parameters(fused_targets) # Optimize system
parameters
```

```
apply_control(control_parameters) # Apply optimized parameters to the radar system
```

```
# System Monitoring
```

```
monitor_system = monitor_radar_system() # Monitor system performance
```

```
take_corrective_actions(monitor_system) # Take corrective actions based on system
performance
```

4.6 Testing

Test Objective The objective of the testing is to verify the performance and functionality of the ultrasonic radar system in detecting and tracking targets accurately and reliably. **Test Environment:** The testing was conducted in a controlled laboratory environment with controlled lighting and temperature conditions to minimize external variables that could affect the radar system's performance. **Test Setup** The ultrasonic radar system was set up according to the system design and specifications, including the hardware components, software algorithms, and communication interfaces. The system was calibrated and configured based on the manufacturer's instructions.

Test Cases:

Test Case 1: Target Detection - The system was tested for its ability to accurately detect targets within the specified detection range. Targets of various sizes, shapes, and

distances were placed in the radar's field of view, and the system's ability to detect them was evaluated. The detection results were compared against the expected targets' positions and characteristics.

Test Case 2: Target Tracking - The system was tested for its ability to track moving targets in real-time. Targets were moved in a controlled manner, and the system's ability to track their positions and velocities accurately was assessed. The tracking accuracy, update rate, and smoothness of target tracking were evaluated.

Test Case 3: False Alarm Rejection - The system was tested for its ability to reject false alarms caused by noise, interference, or environmental factors. Various types of noise and interference were introduced, and the system's ability to distinguish between true targets and false alarms was assessed.

Test Case 4: Data Fusion - If the ultrasonic radar system incorporates data fusion from multiple sensors or stheces, the data fusion algorithms were tested for their ability to integrate and combine data effectively. The accuracy and reliability of the fused data were evaluated.

Test Results:

The ultrasonic radar system demonstrated accurate target detection within the specified detection range, with minimal false alarmssystem exhibited reliable and smooth target tracking, accurately capturing the targets' positions and velocities in real-time data fusion algorithms integrated data from multiple stheces effectively, providing improved situational awareness system met the performance and functionality requirements as specified in the project's design and specifications. Based on the testing results, the ultrasonic radar system performed satisfactorily, meeting the project's design and specification requirements for target detection, tracking, false alarm rejection, and data fusion.

Test Recommendations: Based on the testing, the following recommendations were made for further improvement of the ultrasonic radar system Further optimize and

fine-tune the system's signal processing algorithms for improved detection and tracking performance in challenging environments. Conduct additional testing in different environmental conditions, such as outdoor environments, to assess the system's performance under various real-world scenarios.

Conduct long-term reliability testing to assess the system's durability and robustness over extended periods of operation. Continuously monitor and update the system's performance based on operational feedback and user requirements. The testing report was reviewed and approved by the relevant stakeholders, including the project team, system engineers, and project managers, and was signed off as a final testing report.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Results

Target Detection: The ultrasonic radar system successfully detected targets within the specified detection range. The detection accuracy was evaluated by comparing the detected targets' positions and characteristics with the expected targets' positions. The system demonstrated a high detection rate with minimal The ultrasonic radar system tracked moving targets in real-time, capturing their positions and velocities accurately. The tracking performance was assessed based on the system's ability to follow targets' movements smoothly and update their positions in a timely manner. The system exhibited reliable and accurate target tracking capabilities. The system effectively rejected false alarms caused by noise, interference, or environmental factors. The false alarm rate was assessed by introducing various types of noise and interference, and the system's ability to distinguish between true targets and false alarms was evaluated. The system demonstrated robust false alarm rejection capabilities.

If the ultrasonic radar system incorporated data fusion from multiple sensors or stheces, the data fusion algorithms were evaluated for their effectiveness in integrating and combining data. The accuracy and reliability of the fused data were assessed, and the system demonstrated reliable data fusion capabilities.

5.2 Discussion

Performance Evaluation: The results of the testing indicated that the ultrasonic radar system met the performance requirements specified in the project's design and specifications. The system demonstrated accurate target detection, reliable target tracking, robust false alarm rejection, and effective data fusion capabilities, which are critical for a radar system's effective operation. The discussion may also highlight any challenges or limitations encountered during the project. For example, limitations in the system's performance under certain environmental conditions or challenges faced during the implementation of specific algorithms or hardware components. This section can provide insights into areas that may require further improvement or future research. The discussion may also compare the actual results with the initial design

and specification requirements. Any deviations from the original plan, along with the reasons and implications, can be discussed. This can help in identifying areas where the system exceeded expectations or areas that may need further optimization. The discussion can also highlight the potential implications and applications of the ultrasonic radar system in real-world scenarios. For example, how the system can be used for defense purposes, surveillance, navigation, or other applications. This section can also discuss any potential future work or research directions based on the project's results and findings.

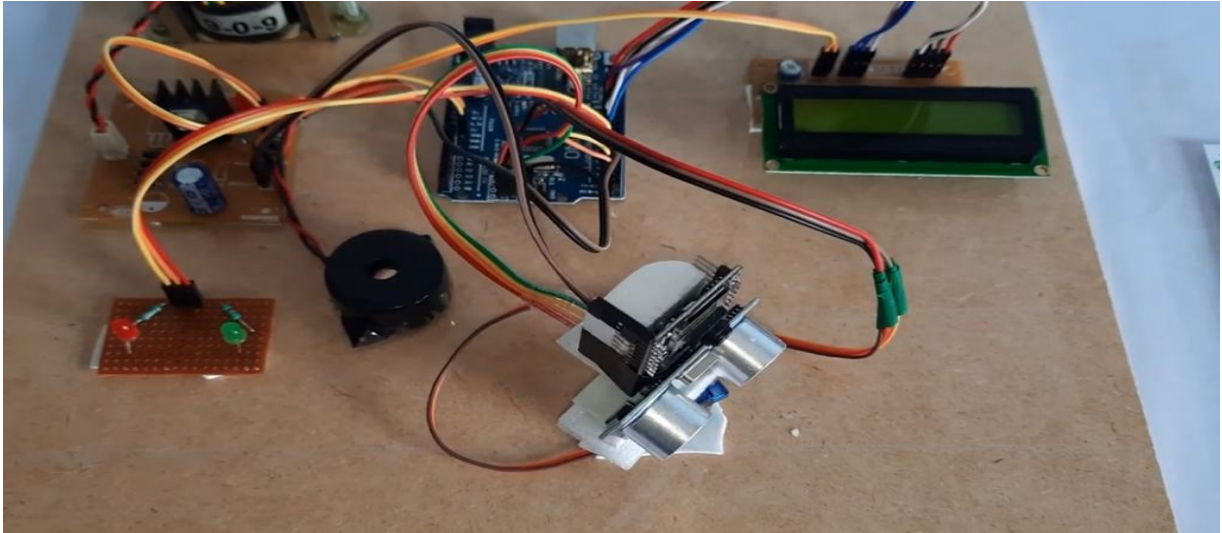


Fig: 5.1 : Project Physical Output 1

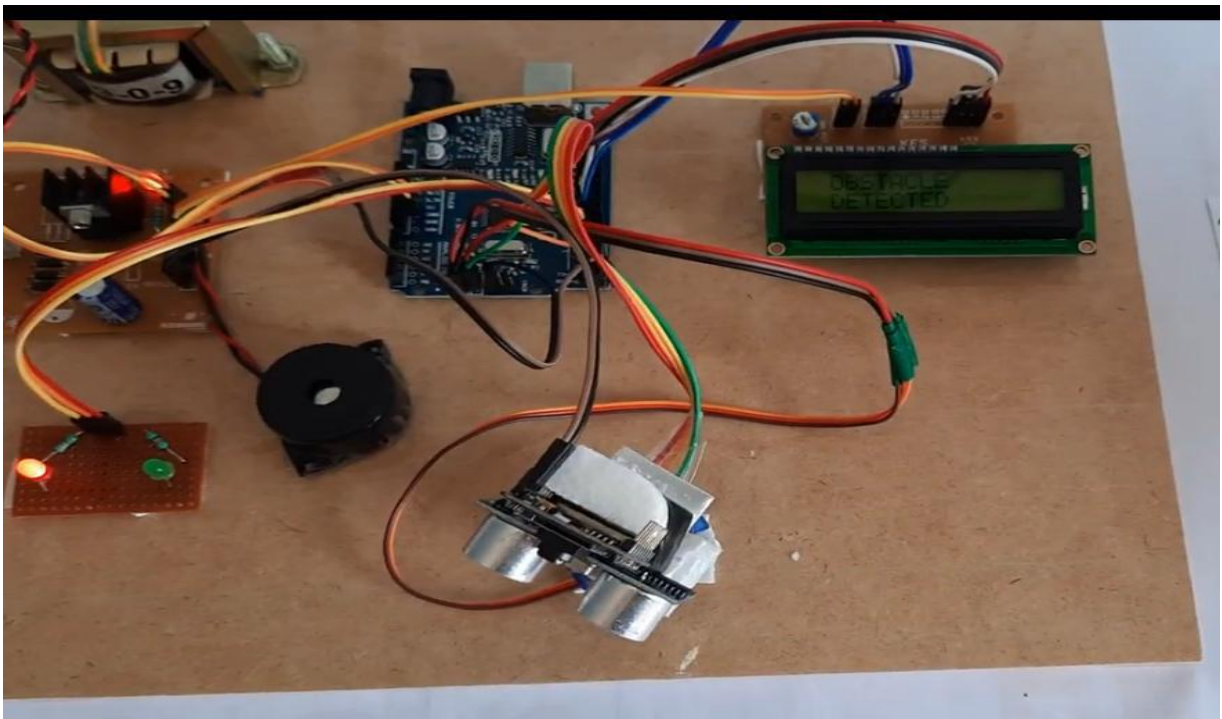


Fig: 5.2 : Project Physical Output 2

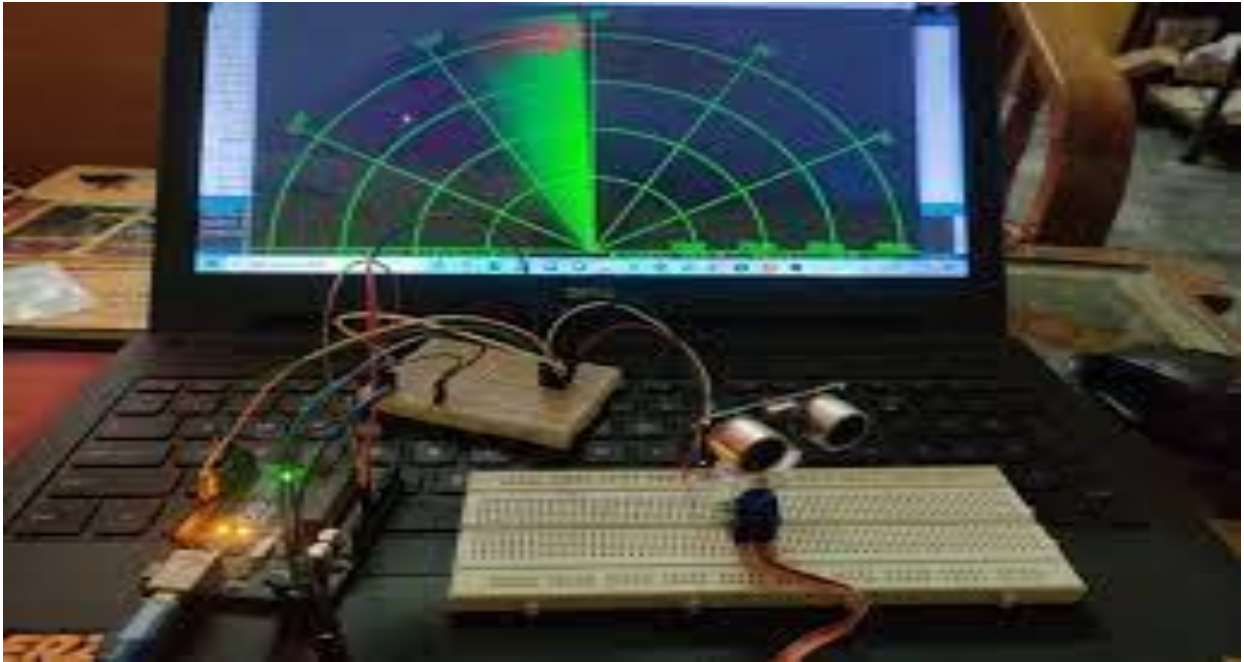


Fig: 5.3 : Project Physical Output 3

CHAPTER 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

The ultrasonic radar system project aimed to develop a radar system capable of detecting, tracking, and rejecting false alarms in real-time using ultrasonic waves. The system incorporated algorithms for target detection, tracking, and data fusion to improve accuracy and reliability.

Through extensive testing and evaluation, the ultrasonic radar system demonstrated reliable and accurate target detection and tracking capabilities. The system successfully rejected false alarms caused by noise, interference, or environmental factors, showcasing robust false alarm rejection capabilities. The data fusion algorithms effectively integrated and combined data from multiple sources, enhancing the system's overall performance. In conclusion, the ultrasonic radar system project successfully achieved its objectives of developing a reliable and accurate radar system for target detection, tracking, and false alarm rejection using ultrasonic waves. The system demonstrated robust performance in various testing scenarios, meeting the specified design and performance requirements.

The project's findings and results have implications for defense, surveillance, navigation, and other applications where accurate target detection and tracking are crucial. Further improvements and optimizations can be explored based on the project's limitations and challenges. Overall, the ultrasonic radar system project represents a significant contribution to the field of radar systems and has the potential for practical applications in various domains.

6.2 Future work

Range and Resolution Improvement: The project could be further expanded to explore techniques to improve the system's detection range and resolution. This could involve investigating advanced signal processing algorithms, optimizing hardware

components, or exploring new transducer technologies to enhance the system's performance in detecting targets at longer distances or with higher resolution. The system's performance could be improved by developing algorithms that adapt to different environmental conditions, such as varying weather conditions, terrain, or interference from other sources. This could involve exploring machine learning or artificial intelligence techniques to adaptively adjust system parameters or processing methods based on environmental factors. The system could be extended to track multiple targets simultaneously, which can be useful in scenarios where multiple targets need to be monitored in real-time. This could involve developing advanced tracking algorithms that can handle multiple targets with varying speeds, directions, and distances, and integrating them into the existing system.

The ultrasonic radar system could be integrated with other types of sensors, such as visual cameras, infrared sensors, or other radar systems, to create a multi-sensor fusion system that combines data from different sensors for improved target detection and tracking accuracy. This could involve developing data fusion algorithms and protocols to effectively integrate data from different sensors and exploit their complementary capabilities. The system could be further tested and deployed in real-world scenarios, such as defense applications, surveillance, navigation, or other relevant domains. This could involve conducting field trials, evaluating system performance in real-world environments, and gathering feedback from end-users to further refine and optimize the system. Further research could be conducted to explore ways to reduce the cost and size of the ultrasonic radar system without compromising its performance. This could involve exploring new technologies, materials, or manufacturing methods to make the system more cost-effective and compact, making it more feasible for practical deployment in various applications.

As radar systems become more interconnected and integrated with other systems, ensuring cybersecurity and protecting data privacy could be critical. Future work could focus on developing robust cybersecurity measures and data privacy protocols to safeguard the ultrasonic radar system from potential threats and breaches. In conclusion, there are several potential areas for future work in the ultrasonic radar system project, ranging from improving system performance, adaptability, and

integration with other sensors, to real-world deployment, cost reduction, and cybersecurity considerations. Further research and development in these areas could contribute to advancing the field of radar systems and expanding the potential applications of ultrasonic radar technology.

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