Design a Hardware model of RFID based Tracking System

Thesis Submitted in partial fulfillment of the requirements for the degree of

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By

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Exam Roll No: M6VLS22006

UNDER THE GUIDANCE

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FACULTY OF ENGINEERING & TECHNOLOGY

JADAVPUR UNIVERSITY

Certificate of Recommendation

I hereby recommend that this Thesis prepared by **Susanta Mondal** entitled "**Design a Hardware model of RFID based Tracking System**" (Registration No. **150134 of 2019-2020,** Exam Roll No. **M6VLS22006**) under my supervision be accepted for partial fulfilment of the requirements for the award of the Degree of Master of Technology in VLSI Design and Microelectronics under Electronics and Telecommunication Engineering Department.

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Certificate of Approval *

The foregoing thesis titled "**Design a Hardware model of RFID based Tracking System"** is hereby approved as a creditable study of Master of Technology in VLSI Design and Microelectronics and presented in a manner satisfactory to warrant its acceptance as a prerequisite to the degree for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion therein but approve this thesis only for the purpose for which it is submitted.

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I hereby declare that this thesis contains literature survey and original research work by myself as a part of my Master of Technology in VLSI Design and Microelectronics studies.

All information in this document has been obtained and presented in accordance with academic rules and ethical conduct.

I also declare that, as required by this rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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CONTENTS

ABSTRACT

Radio frequency identification (RFID) technology has quickly advanced, and it already has significant uses in a variety of industries, One of the important use of RFID is the positioning system. As for some cases, GPS system is affected when the target is within the room. Due to this more complicated inside environment, positioning systems are more likely to be inaccurate or unreliable. Ways to swiftly prepare focused indoor new technologies, making radio frequency technology a star sought after by academics and scientific research facilities.

along with people's living conditions are improving as a result of the expansion of social services, Also Data communication for wireless communication is critical. However, secure data transfer is also necessary; otherwise, a hacker might take control of the data transmission.

So there is an imperious need to adapt the complex scenario that is the new positioning technology. Radio Frequency Identification is the next generation new positioning technology. RFID is a contactless technology that identifies objects that are attached with tags. Tags consist of microchip and antenna. RFID readers obtained the information about the object and the surrounding through communication with tag antenna. In

recent years, RFID technology have a wide range of applications in all aspects of life and production, such as logistics tracking, car alarm, security and other items.

The use of RFID technology to track object, it is a new approach of research. Due to high stability, the error is small and low-cost of RFID tracking technology system, used to build location algorithm is the focus of this study.

In this thesis I have tried to design a hardware model of RFID based tracking system. As a case study I have developed an algorithm for RFID based tracking system. In order to corroborate my design and implemented system I have verified my proposed system using simulated environment. For this purpose an experimental test bench is created and the obtained results exhibited a good agreement with the algorithm. The results are found satisfactory. Also in this paper I discussed the application of my proposed system in a live project.

CHAPTER 1: Introduction

1.1 Background

Radio frequency identification (RFID) technology has quickly advanced, and it already has significant uses in a variety of industries. The development of RFID began at the start of World War II. However, because of the technology's very expensive cost, it was only employed in military strategic studies for a very long period after the war. In the 1990s, chip and electronic technology started to become extensively employed across the world. RFID just recently entered the sphere of civilian manufacturing, but it hasn't been successfully developed and deployed in our nation.

China started to develop RFID technology when it released the "China RFID Technology White Paper" up to February 2006. The use of RFID in various identification, security, anti-counterfeiting, and other areas has now been investigated. The previous art is better developed in terms of positioning technology. China produced the Big Dipper global positioning system, which has a reasonably high precision and is frequently used in military combat and nautical terminology. The US developed the GPS global positioning system, which is frequently utilised in Europe's Galileo global positioning system.

1.2 Basic of RFID:

Radio frequency identification is abbreviated as RFID it’s a technique that uses radio waves frequency to automatically identify humans animals and things the object that we want to identify is physically bonded to an RFID device tag this is referred to as tagging and the item is referred to as being tagged in the case of an animal it may be an injectable tag whereas in the case of a human it could be a wristband or an id card

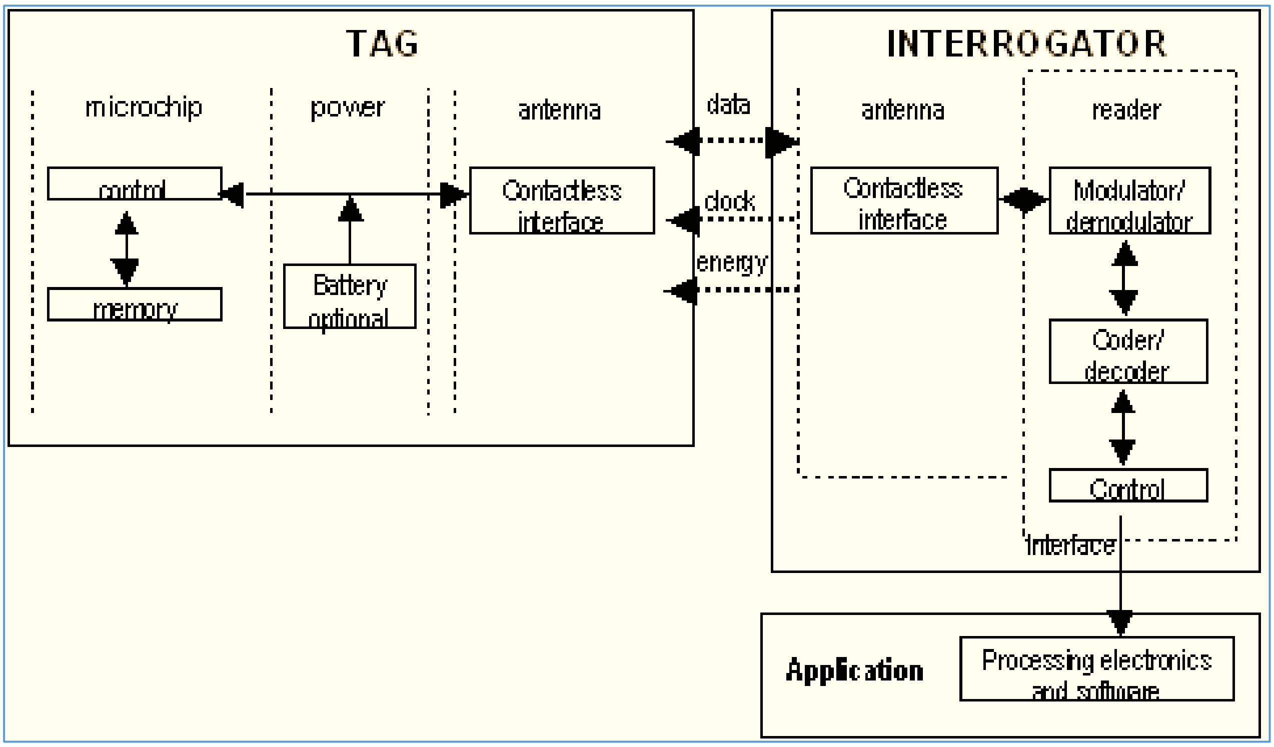


Figure 1. component of RFID system

1.3 Components of RFID systems:

An RFID system always has two main components:

1. The transponder, which is located on the object to be identified,
2. Detector or reader, which depends upon design and the technology It might be a read/write or write/read device.
3. A reader usually consists of a high frequency module (transmitter and receiver), a control unit, and a transponder coupling device. Many readers also include an extra interface (RS232, RS485) that allows them to send the data they receive to another system (PC, robot control system). The transponder, which is an RFID system's actual data-carrying device, is typically made up of a coupling element and an electronic microchip. When the transponder is not inside the response range limit and doesn't have its internal voltage supply (battery), it is completely passive. When the transponders are within range of the reader, they are activated. The power necessary to activate the transponders, as well as the timing pulse and data, are sent to the transponders through the coupling unit (contactless).

1.4 Types of RFID TAGs:

Read-Only and Read/Write RFID tags are divided into two groups based on their data storing capacity. The majority of Read-Only tags lack data storage. They just have a pre-programmed unique ID that refers to a database, which contains information on the object to which the tag is attached. There are two types of RFID tags: active and passive. In order to be activated, passive tags rely on the electromagnetic field created by the RFID reader.

Active tags contain built-in batteries, which extends the system's range by eliminating the need for the tags to be triggered by the reader's electromagnetic field. The strength of the tags, however, may be limited. by the tags' actual size as well as local radio licencing laws.

1.5 Difference between active and passive tags:

PARAMETERS	ACTIVE RFID TAGS	PASSIVE RFID TAGS
Tag power source	Internal to tag	Energy transferred from the reader
Availability of tag power	Continuous	Only when found in the field of the reader
Required signal strength from reader to tag	Low	High
Available signal strength from	High	Low
tag to reader		
Communication range	Long range	Short range

Multi-tag collection	Scanning of 1000 of TAGS from a single reader Scanning of up to 20 TAGS moving at more than 100 miles/hour	Scanning of 1000 of TAGS within 3 meters from a single reader Scanning of up to 20 TAGS moving at more than 3 miles/hour or slower
Sensor capability	Ability to monitor continuously	Monitor sensor input when tag is powered from the reader
Data storage	Large	Small

1.6 Frequency of use of RFID system in different countries:

Frequency	Countries
125-134 kHz	USA, Canada, Japan, Europe
13.56 MHz	USA, Canada, Japan, Europe
433.05-434.79 MHz	In most of USA and Europe and under consideration Japan
865-868 MHz	Europe
866-869 and 923-925 MHz	South Korea
902-928MHz	USA
952-954 MHz	Japan (for passive tags after 2005)
2400-2500 and 5.725-5.875 GHz	USA, Canada, Japan, Europe

The frequencies used in RFID systems are analyzed below:

- 1235-134 kHz: This is a low frequency that allows RFID tags to be detected in groups of less than 0.5m. The average data transfer rate is less than 1 kbit per second, and electromagnetic waves at this frequency pierced water but not metal. This frequency is used to identify animals.

- 13.56 MHz: This frequency allows RFID tags to be detected up to 1.5 metres away. The data transfer rate at this frequency is around 25 kilobits per second, and electromagnetic waves can penetrate water but not metal at this frequency. The frequency is utilised for access and security applications.

- 433-956 MHz: The frequencies in this range are referred to as ultra-high frequencies. RFID tags may be detected at a distance of up to 100 metres using frequencies ranging from 433 to 864 MHz, while RFID tags can be detected over a distance of 0.5 to 5 metres using frequencies ranging from 865 to 956 MHz. The data transfer rate is 100 kbits per second for all frequencies between 433 and 956 MHz. The electromagnetic waves created are incapable of penetrating water or metals. Frequencies in this range are employed in logistical applications.

- 2.45 GHz: An RFID reader can detect a tag from a distance of 10 metres using this frequency. Microwave frequency is the name given to this particular frequency. This frequency has a data transport rate of up to 100 kbits per second. Emissions of electromagnetic waves

The energy created in this situation is incapable of penetrating water or metal. For applications involving mobile vehicle tolls, a specified frequency is employed.

- Spectrum in the 5.9GHz band has been identified by the US Federal Communications Commission (FCC). The frequency of RFID-system usage was summarised in a table of frequent uses for a number of nations. Many attempts have been made to unify RFID frequency use around the globe. The Federal Communication Commission (FCC) has changed its RFID guidelines to align with the European Telecommunication Standards Institute (ETSI) (ETSI). Industrial, Scientific, and Medical (ISM) applications use the frequency 13.553-13.567 MHz. The FCC has also raised the amount of power and bandwidth available, allowing RFID to operate within ETSI's guidelines. 13.410MHz

1.7 Recent trends in RFID:

RFID has a wide range of applications in the corporate world. An XML database consultant may suggest a number of integrated systems to help a firm become more lucrative and efficient. Here are a few advantages that technology may give.

Inventories that are more accurate:

RFID-tags may be used to make inventorying products quicker, faster, and more precise, regardless of what industry you're in. Because the tags are more sensitive and can be read from a greater distance, they are projected to eventually replace barcodes.

Increase Safety:

The tags provide better patient safety in medical communication. Pharmacies are better at keeping track of medications and keeping them out of the wrong hands. When sponges and other tiny things are marked, surgical operations are made safer. It is simple to calculate the number present before and after the process. The chances of leaving a sponge in a patient, the most common mistake, are considerably decreased.

Increase Security:

Tracking employee mobility, the opening and closing of doors, the transfer of assets, and other changes in the facility is getting easier for security professionals in firms where security is a top priority. Cameras can malfunction or be bypassed by cunning burglars. Cameras are almost obsolete with the correct RFID application and software packages.

Easier Payment Collection:

For delivery drivers or service providers, an XML database expert could offer an automated payment collecting solution. Mobile phones and tags that operate as credit card readers can be used to make and receive payments. This decreases the amount of documentation needed for billing and the number of personnel needed to complete the task. It also lowers the chances of bad debt.

Increased Efficiency in Shipping Yards:

All of the shipping and freight distribution corporations that are using the latest RFID solutions would be acquainted to an XML database specialist. Owners of businesses are pleased with the outcomes due to increased efficiency and lower losses.

Increased Profitability: Regardless of the sort of business, all of the advantages add up to one thing: increased profitability. That means more money in your pocket. In every scenario, the systems should be adapted to the company's particular requirements. This is when the services of an XML database consultant and designer come in handy. XML coding is used in almost every office programmer. It's preferable to leave programming the code to operate with the tags and readers to the professionals. Designers will evaluate your company's data storage requirements, among other factors. They may also provide you more details about the most recent RFID application.

1.8 Application of RFID systems:

RFID technology has shown to be effective in a variety of scientific and technological sectors, including medicine and engineering. RFID tagging is utilised in blood transfusion and analysis in medicine. An RFID tag that holds information about a specific patient can be affixed to a wristband. A wireless reader communicates with the tag, and the information contained in the tag is shown on the consultant's mobile device's screen. An RFID scanner examines the tags connected to the blood bags and locates the proper blood bags for the patents. RFID technology has also been used in the supply chain of the aerospace sector. Boeing, in particular, has marked boxes containing aviation equipment. 0 is the code class for passive electronic goods. These boxes have RFID tags affixed to them that include information such as a unique ID number that can be read by RFID readers at a depot. Boeing then provides the depot an advance report on the contents of the tag. This data includes a list of the contents of the container, the amount, the provenance, and the purchase contract. The information is manually entered into the wide area workflow (WAWF) system by a Boeing employee. When the laden crates are transported, the creates are affixed to them. These numbers refer to a database, the contents of which are included in Boeing's advance shipping report. The precise assembly of pipe work systems with the correct gaskets, nuts, and torque is an important factor in the building and maintenance of oil facilities. A faulty assembly might result in leaks, posing a safety risk in an oil refinery. Individual pipework and process equipment may be recognised using RFID tags. RFID tags that capture technical information can be installed in pipeline valves. These tags may be scanned with an RFID reader to determine whether a valve is the right one, in the right place, and at the right pressure. RFID technology is also utilised to track the movement of gasoline tankers and to control equipment maintenance. RFID technology is employed in the manufacture of new automobiles in the automotive sector. RFID tags, for example, may be applied to automotive parts and tracked during the assembly process. Because each client in the automobile sector may have distinct preferences for how his or her car should be built, RFID tags enable for faster tracking of the needed components and the prevention of any problems caused by wrong component placement. RFID tags are used in the retail business to identify and monitor items as they move through the supply chain. The tags may be connected to actual goods like pens or toothpastes and broadcast an identifying signal that allows them to communicate with an RFID reader or other tags. In the Auto-ID system, an example of a consumer products tracking system. This method employs the Electronic Product Code (EPC), a numbering mechanism that may issue a unique ID to any physical thing on the planet. In the retail business, Auto-ID uses an RFID tag to assign a unique ID to a specific product, which the tag subsequently communicates to an RFID reader, allowing the object to be identified.

a). DIT - Department of Information Technology: CDAC NOIDA and IIT KANPURE have collaborated on the creation of a single pilot application employing RFID technology. Preliminary work on establishing a state-of-the-art RFID lab in the country will be advanced as part of this project, with the goal of making this lab the world's eighth Auto ID lab.

b). Department of Road Transport and Highways: On the Delhi-Jaipur route in India, T.R. Baalu, Minister of Road Transport and Highways, Government of India, announced a pilot project for RFID-based vehicle monitoring.

c). CRIS-Centre for Railroads Information System: The Indian Railways' Centre for Railway Information System intends to employ RFID to enhance the railways' waggon management system.

d). Wipro's Manufacturing Solution's Center of Excellence (CoE) includes a specialised team of consultants that assist companies identify, assess, create, and execute RFID solutions.

e).Infosys and RFID:

Infosys Technologies (NASDAQ:INFY) announced today that the SAP solution for RFID for CHEP's Global Track and Trace system has been successfully implemented. CHEP, a global leader in pallet and container pooling services, plans to use this technology to give its clients real-time visibility into their products as well as tracking assets on which they are delivered.

f). Animal Tracking:

The Kopordem farm in Valpoi, Sattari Talluk, North Goa, has become India's first farm to deploy RFID micro chips that may be affixed to the animal's body for tracking and other uses.

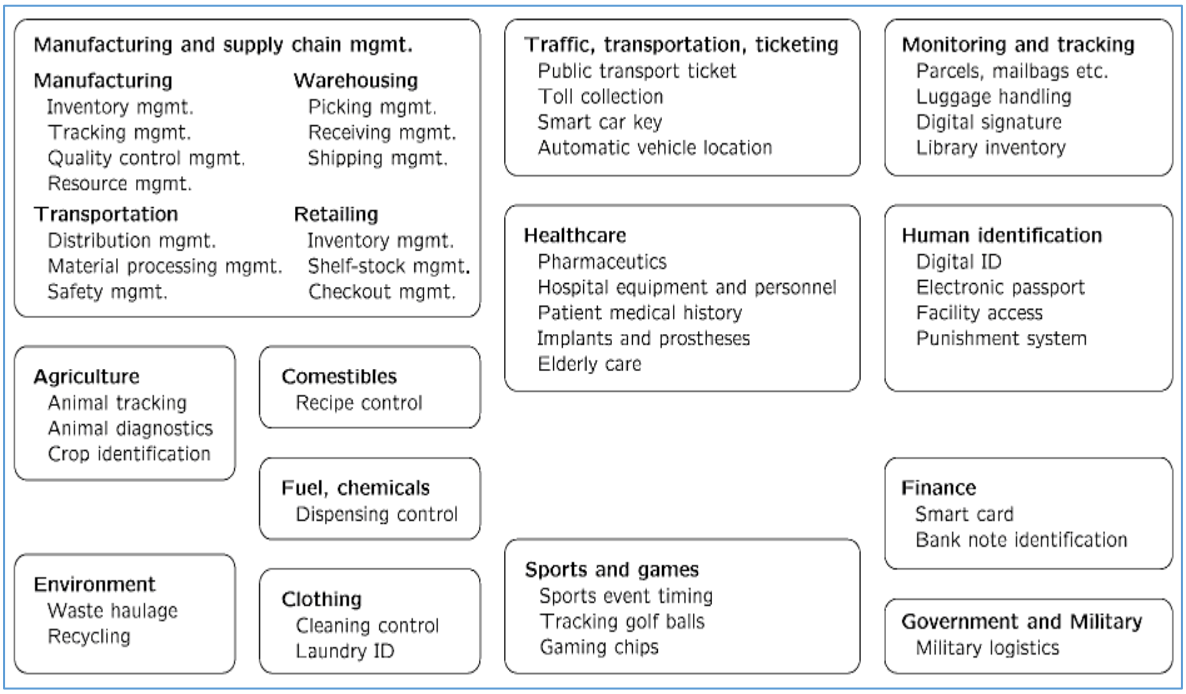


Fig 2: Application area of RFID

CHAPTER 2: LITERATURE SURVEY

In this chapter, the latest findings of RFID based tracking systems are presented. I begin with a review of development of the idea of the RFID based tracking system, and their future prospects in a theoretical perspective. Then I look at various experimental realizations of RFID based tracking system. Finally, I discuss the latest developments made in modelling of RFID based tracking system.

2.1. In 2014, Jianqiang et.al. A paper titled "RFID-Based Vehicle Positioning and Its Applications in Connected Vehicles". This article developed an RFID-based vehicle location solution. In connected car applications where GPS is unavailable or of insufficient quality, this study suggests an RFID technique as a useful alternative to locating. Estimation must be conducted based on the most recent location update from tags to fill gaps between tags. To confirm the RFID-based positioning approach, road tests are conducted. On-board radar and an RFID reader are used in one type of experiment. The radar is utilized to provide the test vehicle's "actual" positions, which are compared to estimates using RFID-based positioning. The result reveals an excellent match between the two vehicle position sources. The other sort of experiment looks to see if the estimated position from the kinematics integration matches the position determined by the tags. The assessment of vehicle position is triggered by a photoelectric switch depending on the most recent tag update. The results show that during acceleration or deceleration, the position inaccuracy is roughly 5.4%, and around 2.5% when the speed is rather stable.

2.2. In 2015, Enrique et.al. demonstrated "Evolution of RFID Applications in Construction a Literature Review". They suggested using RFID as a locating alternative in connected car applications if GPS is unavailable or of poor quality. RFID tags are placed on the road surface, and automobiles have on-board tag scanners. When a reader passes over a tag, the position information recorded in the tag can be read. RFID allows for the control of a wide range of processes at various stages of a building's lifecycle, from conception to occupancy.

2.3. In 2004, George et.al. demonstrated "An RFID Based Luggage & Passenger Tracking System For Airport Security Control Applications".

According to the author, One of the most difficult tasks in the security field is airport security. Airports are enormously crowded public spaces, making them prime targets for terrorist attacks, with planes, passengers, crew, and airport infrastructure all vulnerable. Within this maze of security issues, UHF passive RFID technology's long-range detection capacity can be turned into a critical tracking tool that can beat all of the limits of barcode tracking within the current airport security control chain. This article discusses the system's application scenarios, which are organized according to the structured nature of the environment, as well as the system architecture and assessment findings derived from measurements with a variety of GEN2 UHF RFID tags that are widely available in the market. the global market

The use of passive RFID technology for airport security controls and security logistics has numerous advantages in this area. The viability of indoor localization using RFID has been investigated. Passive RFID tags are inexpensive, and because of their small size, they can be easily attached to objects without interfering with existing security procedures, such as luggage tags, or even printed as part of them. RFID, which has already been extensively tested in the logistics industry, can quickly deliver readings from various entities and across relatively vast areas, and the lack of a battery simplifies use case logistics and boosts the system's robustness. RFID also enables a range of novel airport uses, such as "positive baggage." boarded ", such as locating passengers and directing them to the gate in a timely manner to avoid delays, or self-boarding apps. Furthermore, RFID tagging can be used to give a reliable means of assessing the effectiveness of the security screening process, as well as to identify bottlenecks in the process and improve the overall efficiency of the boarding process logistically. The RFID Based Luggage & Passenger Tracking System was a vital aspect of the TASS multi-level surveillance and intelligence system, which integrates and fuses data from many types of real-time sensors and subsystems in the framework of the TASS project. boarded ", such as locating passengers and directing them to the gate in a timely manner to avoid delays, or self-boarding apps. Furthermore, RFID tagging can be used to give a trustworthy method of measurement. The efficiency of the security checking process can be utilized to detect bottlenecks in the process and, as a result, the overall boarding process logistics can be improved. The RFID Based Luggage & Passenger Tracking System was a vital aspect of the TASS multi-level surveillance and intelligence system, which integrates and fuses data from many types of real-time sensors and subsystems in the framework of the TASS project.

2.4. In 2016, Zi Min et.al. demonstrated "RFID Location Algorithm"

According to the author, RFID technology has a wide range of uses in all sectors of life and manufacturing, including logistics tracking, automobile alarms, security, and a variety of other things. In the views of numerous research organizations and researchers, the use of RFID technology to locate is a new direction. This research focuses on RFID positioning technology system stability, small error, and low-cost advantages of its location algorithm.

The layers of RFID technology targeting approaches and algorithms are examined in this article. First, many basic RFID approaches are introduced; Second, a strategy for locating political networks with greater accuracy will be described; last, the LANDMARC algorithm will be described.

In the field of RFID positioning technology, now commonly used positioning divided into three areas, namely:

(1) To reach the positioning information,

(2) Positioning signal strength,

(3) Measuring the azimuth positioning.

It can be observed from this that innovative and efficient algorithms play a significant role in improving RFID positioning accuracy. Finally, the algorithm is implemented. Finally, the RFID location technology algorithm is summarized, highlighting flaws in the algorithm and proposing a follow-up research of the needs, as well as a vision for a better future RFID positioning technology.

2.5 In 2016, Qiushi et.al. demonstrated "Research and Implementation of an RFID Object Tracking System Simulation Platform "

According to the author, For its useful application in space-time information query, radio frequency identification (RFID) has been the focus of research. Due to the difficulty of conducting experiments in real RFID application systems, this work presents an RFID object tracking system simulation platform to aid in the study of RFID uncertain data management and space-time information query. This work proposes a simulation technique that combines discrete event scheduling and activity scanning after investigating simulation models of the reader, tag, and radio propagation in the physical and logical layers. Three layers based on Eclipse RCP and GEF implement the platform. The system can simply be expanded by adding a new plug-in created by the user. Finally, a simple object tracking test is performed to demonstrate. Finally, a rudimentary object tracking test is shown to demonstrate that it can accurately mimic RFID application scenes and can aid research in this sector.

Entities, characteristics, and activities are all part of a simulation system.

There are three essential components. The objects that make up the system are known as entities. Readers, tags, radio propagation techniques, environment features, inner processing units, and other entities are included in this system. These elements are not only self-contained, but they can also be combined to form a whole. A property is a description of an entity's characteristics that is conveyed by a parameter or variable. A reader's attributes, for example, include transmit power, working frequency, cache volume, capture ratio, and so on. An activity is a process that an entity does over a period of time, such as a reader transmitting data packages, a data package being wirelessly transferred, a tag receiving and backscattering data packages, and so on. To elucidate the RFID's nature, He provides a non-form description of the RFID system model for our simulation system. This article creates and builds a single-machine RFID object tracking system simulation platform. The platform's key contribution is its elegant architecture and high extensibility. It has been demonstrated through testing that it can help with RFID uncertain data management and space-time information query research.

2.6. In 2017, Gaurav et.al. demonstrated "RFID based Tracking System"

According to the author, RFID (Radio Frequency Identification) is on its way, and it'll bring a streamlined revolution with it. When it comes to tracking devices, Radio Frequency Identification (RFID) is the most recent development in decades that can be utilized as an effective tracker. The invention of a tracking system based on Radio Frequency Identification (RFID) technology is relatively new, but it has a lot of potential. This system employs RFID technology to track employees' official assets as they enter and exit the building (E.g. laptops). The Tracking System is based on an external database system that will offer the reader's recorded information. Because the database has detected the reader, the tracking system will process the data and display the subject tracking results. In the corporate world, RFID tracking has exploded in popularity. One of the main problems is its movement in and out of the office on a daily basis. This makes Instruments vulnerable to theft, resulting in the loss of not only an asset but also valuable and sensitive data. It is critical for the business to guarantee that the correct laptop is brought into and out of the facility. This system employs RFID technology to track employees' official laptops' entry and exit (devices). The goal of this solution is to shorten long lines at corporate gates by limiting manual checks to visitors and staff using prohibited laptops. Each employee will be stored in the company's master HR database. Employee id card (RFID-based I Card) with laptop tag (RFID based tag adhered to the laptop). If an employee enters or exits the corporate gates with an approved laptop, the manual inspections can be skipped, saving both time and money.

2.7. In 2013, Tanvir et.al. demonstrated "RFID based Tracking System"

According to the author, Baggage handling at airports is far from perfect. Baggage gets on the wrong flight, is left behind, or is lost, which costs the airlines money and causes passengers frustration. To address the situation, we present a data warehouse (DW) solution for storing and analyzing spatiotemporal RFID baggage tracking data. Analysis of this data can yield interesting results on baggage flow, the causes of baggage mishandling, and the parties responsible for the mishandling (airline, airport, handler,...), leading to improved baggage handling quality.

The paper describes a well-designed data warehouse (DW) with a relational schema sitting beneath a multidimensional data cube that can handle the data's many complexities. The paper also goes over the Extract-Transform-Load (ETL) flow, which is responsible for loading the data warehouse with the appropriate tracking data from the data sources. The concepts presented here can be applied to other types of multi-site indoor tracking systems based on Bluetooth and RFID. A large amount of real-world RFID-based baggage tracking data from a major industry initiative was used to test the system. The developed solution reveals interesting insights while also being several orders of magnitude faster than computing the results directly on the data sources. A multidimensional database warehouse solution for RFID-based baggage monitoring data is presented in this research. To our knowledge, this is the first study to design a multidimensional data warehouse for this significant area, incorporating a relational DW schema with a data cube on top. The suggested data warehouse aids the airline baggage handling process by providing a framework for data analysis and complicated query responses, which can help to improve baggage handling quality.

CHAPTER 3:

Algorithm formation and Hardware model design

- ➢ Define the algorithm
- ➢ Flow chart of proposed system
- ➢ Mathematical calculation
- ➢ block diagram representation of hardware model
- ➢ Convert each block to its equivalent circuit.
- ➢ Final circuit design

Various research papers have been discussed to define RFID based tracking system for different purpose. In this paper first I have designed an algorithm for my prosed system. In my work theoretical description as well as diagrammatical description is discussed here.

In the field of RFID positioning technology, commonly used positioning divided into three areas, as follows

- ❖ To reach the positioning information,
- ❖ Positioning signal strength,
- ❖ Measuring the azimuth positioning.

I use this ‘to reach the positioning information’ for my proposed system. As tag sends an acknowledgment signal when it comes to the reader capturing area or frequency zone. We can use this acknowledgment signal to determine the distance between tag and reader.

In my work, I assume that two readers are installed horizontally in straight line within a distance. This distance depends on reader's strength. Also we can installed this readers diagonally.

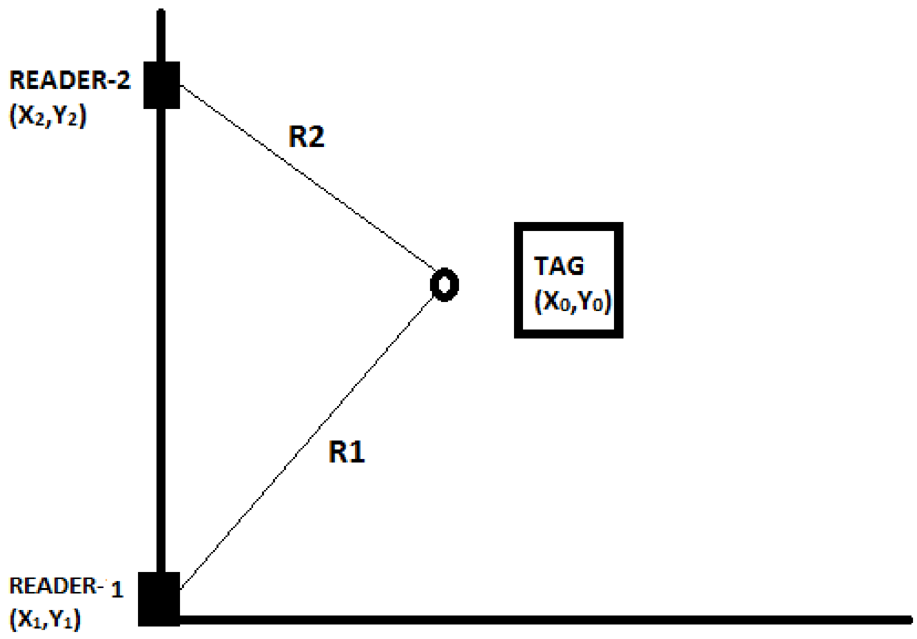
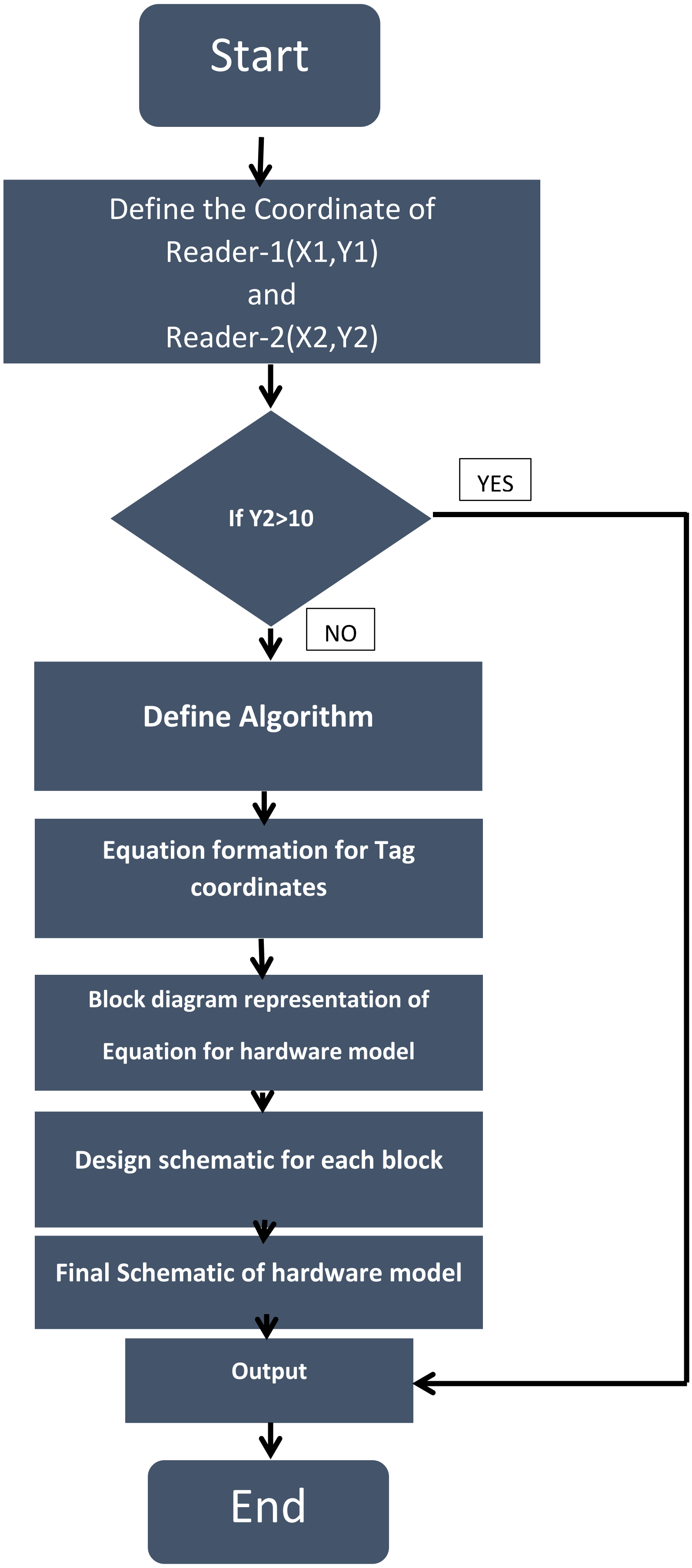


Fig-3

If any tag comes to this reader's frequency zone, Readers identify the tag.

As we know that the speed of propagation of electromagnetic waves in the air of C (3 * 108m / s), the coordinates of two readers also known (Xi, Yi), measured of electromagnetic waves from the target tag to the reader the propagation time T1 and T2, so the distance of the target tag to the reader is Ri = C * Ti, according to the mathematical method, can be assumed that the position coordinates of the target tag (X0, Y0). From this concept I have designed an algorithm for my prosed system. Flowchart of my proposed system is

Flowchart


Start
Define the Coordinate of
Reader-1(X1,Y1)
and
Reader-2(X2,Y2)
If Y2>10
YES
NO
Define Algorithm
Equation formation for Tag coordinates
Block diagram representation of
Equation for hardware model
Design schematic for each block
Final Schematic of hardware model
Output
End

❖ Mathematical calculation

From fig-3, Let co-ordinate of Reader-1 is (x_1, y_1)
co-ordinate of Reader-2 is (x_2, y_2)
co-ordinate of Tag is (x_0, y_0)
R1 and R2 are the distance from reader-1 and reader-2 respectively

When we consider Reader-1 and the co-ordinate(x_1, y_1)

$$(x_1 - x_0)^2 + (y_1 - y_0)^2 = {R_1}^2$$

$${x_1}^2 + {x_0}^2 - 2x_1x_0 + {y_1}^2 + {y_o}^2 - 2y_1y_0 = {R_1}^2$$

$${x_0}^2 + {y_o}^2 - 2x_1x_0 - 2y_1y_0 = {R_1}^2 - ({x_1}^2 + {y_1}^2) \text{ .... } \textbf{(i)}$$

When we consider Reader 2 and the co-ordinate(x2, y2)

$$(x_2 - x_0)^2 + (y_2 - y_0)^2 = {R_2}^2$$

$${x_2}^2 + {x_0}^2 - 2x_2x_0 + {y_2}^2 + {y_o}^2 - 2y_2y_0 = {R_2}^2$$

$${x_0}^2 + {y_o}^2 - 2x_2x_0 - 2y_2y_0 = {R_2}^2 - ({x_2}^2 + {y_2}^2) \text{ .... } \textbf{(ii)}$$

We get the final result as … (i)-(ii)

$$2x_2x_0 - 2x_1x_0 + 2y_2y_0 - 2y_1y_0$$
$$= {R_1}^2 - ({x_1}^2 + {y_1}^2) - {R_2}^2 + ({x_2}^2 + {y_2}^2)$$

$$2x_0(x_2 - x_1) + 2y_0(y_2 - y_1)$$
$$= ({R_1}^2 - {R_2}^2) - ({x_1}^2 + {y_1}^2) + ({x_2}^2 + {y_2}^2)$$

Considering $\mathbf{x_2}$ and $\mathbf{x_1}$ are same, we get

$$\mathbf{y_0} = \frac{(\mathbf{R_1}^2 - \mathbf{R_2}^2) + (\mathbf{x_2}^2 + \mathbf{y_2}^2) - (\mathbf{x_1}^2 + \mathbf{y_1}^2)}{2(\mathbf{y_2} - \mathbf{y_1})}$$

(iii)

By putting the value of $\mathbf{y_0}$ at equation (i) we get the value of x_0

$$\mathbf{x_0} = \sqrt{\frac{\mathbf{R_1}^2 - (\mathbf{x_1}^2 + \mathbf{y_1}^2) + 2\mathbf{y_1}\mathbf{y_0} - \mathbf{y_o}^2}{(1 - 2\mathbf{x_1})}}$$

(IV)

In my proposed system, Reader-1 is installed at (0,0) location and Reader-2 is installed at $(0,y_2)$ location. Y_2 depends on reader strengths. If reader strength is high then Y2 will be large.

So, $x_1 = x_2 = 0$ and $y_1 = 0$,

We can minimise the above equations (iii & IV)

$$\mathbf{x_0} = \sqrt{\mathbf{R_1}^2 - \mathbf{y_o}^2} \quad \text{……….. } \mathbf{(V)}$$

$$\mathbf{y_0} = \frac{(\mathbf{R_1}^2 - \mathbf{R_2}^2) + \mathbf{y_2}^2}{2\mathbf{y_2}} \quad \text{…………… } \mathbf{(VI)}$$

This the final expression of x_0, y_0 to locate the Tag location.

❖ Design block diagram representation of hardware model of algorithm.

Block diagram representation of algorithm is design by Matlab Simulink. First I tried to simulate the algorithm by using block available in Matlab Simulink. This model helps me to predict the behaviour of my proposed system. Also it allows me to extract some data for experimental purpose. Also I am able show the location of a Tag through graphical plot. First I took constant block for input data. Later I will take voltage source as an input. After that multiplier or square block is used to represent the square of R_1, R_2 and Y_2. Then addition, subtraction, division, square root block are taken to represent the whole model.

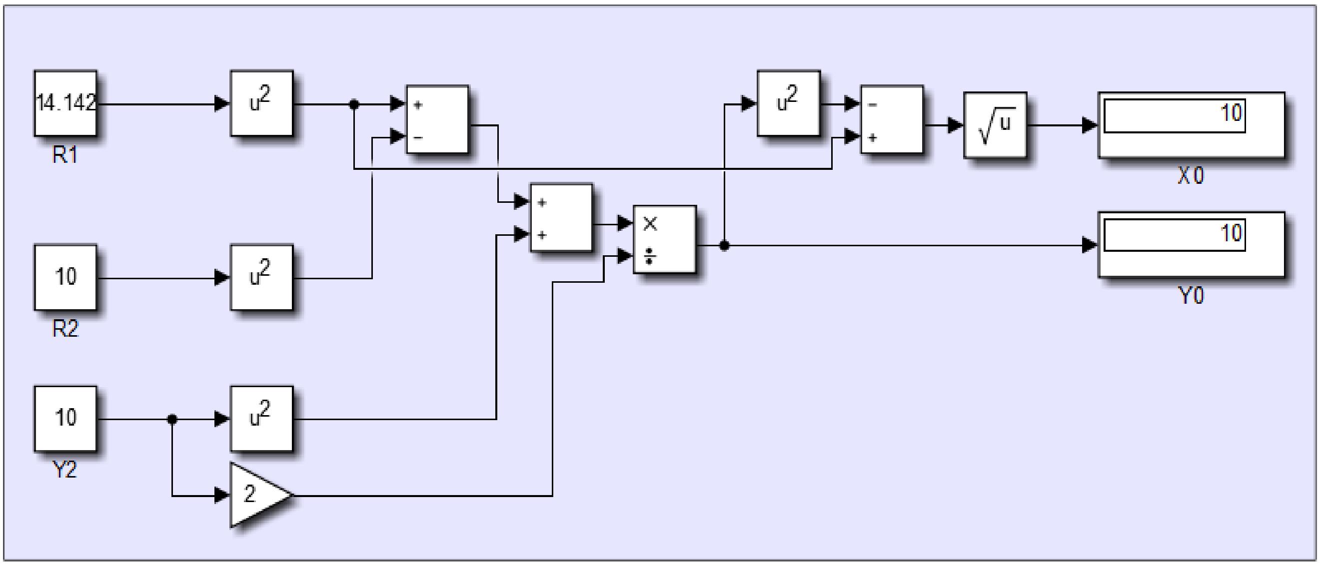


Fig-4. Block diagram representation of Hardware model

The above model gives accurate output as per my algorithm. For this regarding I design an experimental test bench to verify and validate the model. I will explain briefly the test bench and output at Result and discussion chapter-4.

❖ Design schematic of hardware model

In this section I convert each block to its equivalent circuit then I will design full schematic of my proposed system. For this purpose I design the circuit for each block using operation amplifier. Then I simulate in Matlab Simulink.

i. Multiplier circuit using operational amplifier

To generate square of a value, I use multiplier circuit using operational amplifier. Here, same input is given to the two log amplifier. Then outputs of two log amplifier are given to the adder circuit, as addition of two log amplifiers output gives the value in form of multiplication. Now this value has to pass through an antilog amplifier to get an absolute value

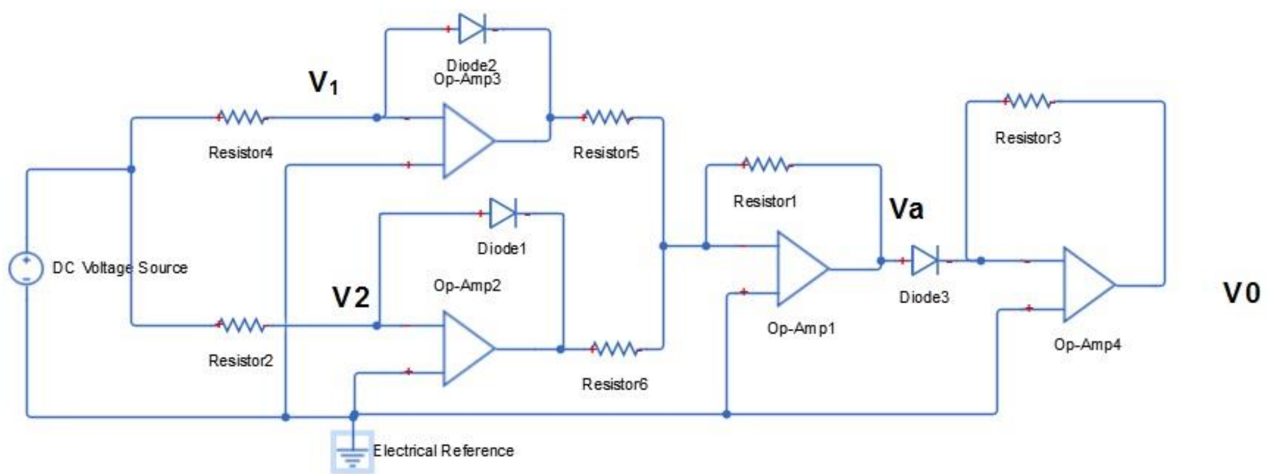


Fig-5

❖ Mathematical expression for Multiplier circuit

$V_{01} = -\eta V_T \log V_1/I_0R$

$V_{02} = -\eta V_T \log V_2/I_0R$

$Va = -(V_{01} + V_{02})$

$= -(-\eta V_T \log V_1/I_0R \ -\eta V_T \log V_2/I_0R)$

$= \eta V_T(\log V_1/I_0R + \log V_2/I_0R)$

$= \eta V_T \log V_1V_2/I_0^2 R^2$

$V_0 = -I_0R \text{ antilog } \eta V_T \log V_1V_2/I_0^2 R^2$

$$V_0 = \frac{-I_0R \text{ antilog } \eta V_T \log V_1V_2/I_0^2R^2}{\eta V_T}$$

$$V_0 = \frac{-I_0R\, V_1V_2}{I_0^2R^2}$$

$$V_0 = \frac{-V_1V_2}{I_0R}$$

$$V_0 = -\text{K}\, V_1V_2$$

ii. Division circuit using operational amplifier

For division inputs are passed through the two log amplifier. Then outputs of two log amplifier are given to the substractor circuit, as subtraction of two log amplifiers output gives the value in form of division. Now this value has to pass through an antilog amplifier to get an absolute value

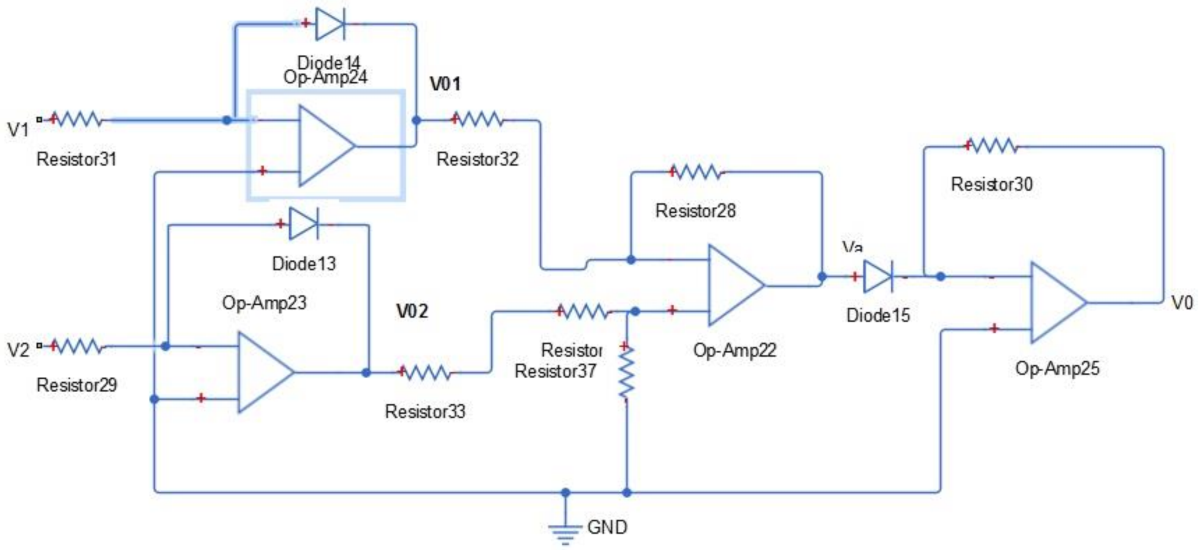


Fig-6

❖ Mathematical expression for Multiplier circuit

$V_{01} = -\eta V_T \log V_1/I_0R$

$V_{02} = -\eta V_T \log V_2/I_0R$

$Va=-(V_{01} - V_{02})$

$=-(-\eta V_T \log V_1/I_0R + \eta V_T \log V_2/I_0R)$

$=\eta V_T(\log V_1/I_0R - \log V_2/I_0R)$

$$= \eta V_T \log V1/V2$$

$$V_0 = -I_0 R \text{ antilog } \eta V_T \log V1/V2$$

$$V_0 = \frac{-I_0 R \text{ antilog } \eta V_T \log V_1/V_2}{\eta V_T}$$

$$V_0 = -I_0 R\, V1/V2$$

$$V_0 = -\kappa\, V_1/V_2$$

iii. Square root using operational amplifier

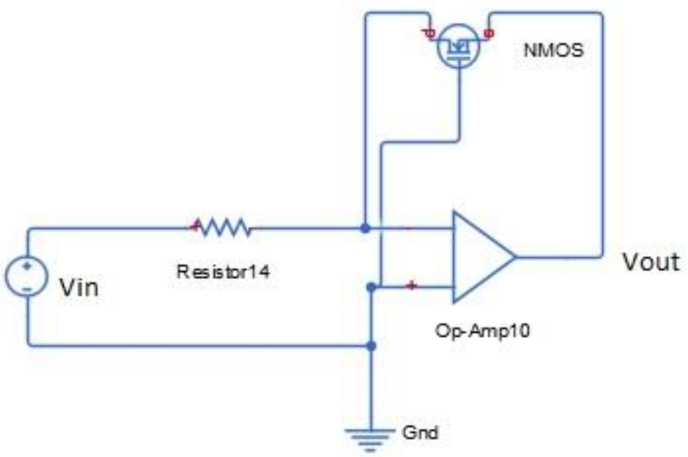


Fig-7

❖ Mathematical expression for Multiplier circuit

$Id=1/2Kn(Vgs-V_{TN})^2$
$Vgs=-Vout$
$Id=1/2Kn(Vout-V_{TN})^2$
$Vout=-\sqrt{(2Vin/KnR)} - V_{TN}$

iv. Adder using operational amplifier

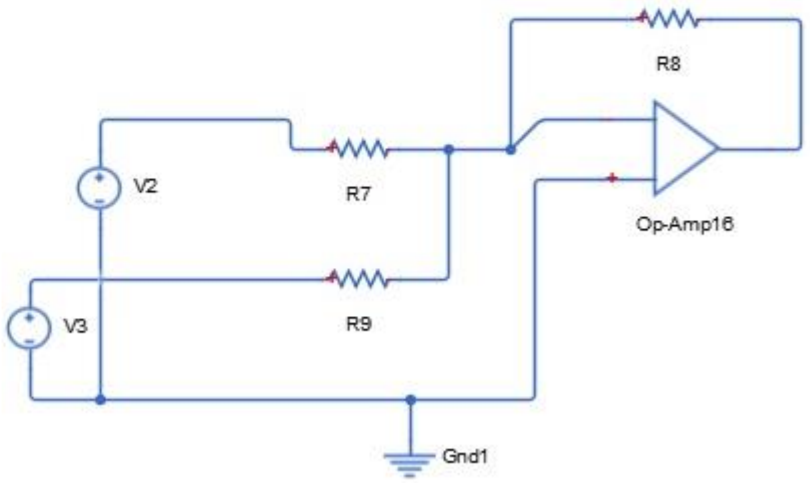


Fig-8

v. Subtractor using operational amplifier

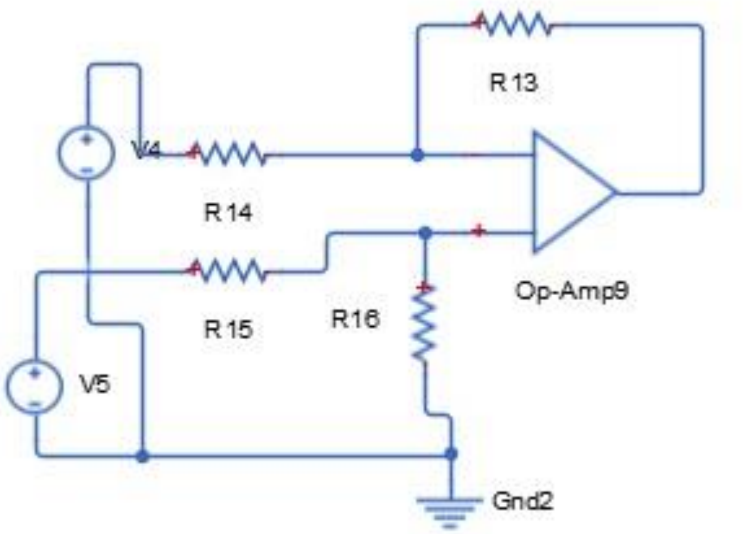


Fig-9

❖ Final schematic of Hardware model

This is the complete schematic of proposed model. Circuit is working properly. I have verified this circuit with some predefine condition that is discussed in nest chapter. Here, value of Y2 (distance between two readers) and Tags distance (R1 & R2) from Reader are given through voltage source. Then circuit process this signals according to algorithm and output is observed in display. Also graphical location is shown in plot window to know exact location of a selected tag.

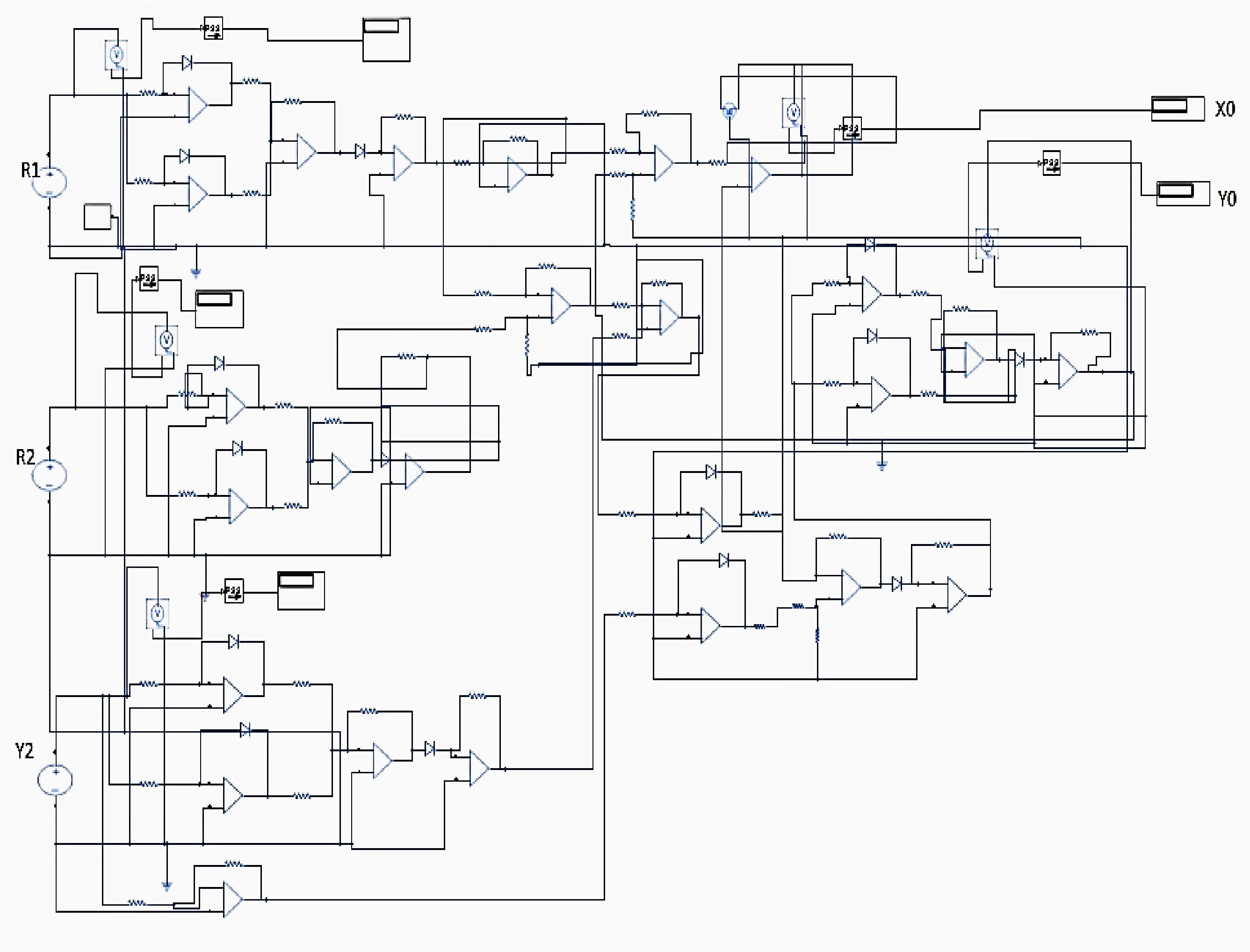


Fig-10- Schematic of Hardware model

CHAPTER 4: Results And Discussion

To verify and validate the developed model, an experimental test bench is created and the obtained results exhibited a good agreement with the algorithm. Here, I created four test bench for this purpose.

1) Test-1:

Let, distance between two Readers, y_2= 10m

Tag distance from Reader-1, R_1=5m

Tag distance from Reader-2, R_2=5m

Putting this value in equation (V) & (VI), I get

$$\mathbf{y_0} = \frac{(\mathbf{R_1}^2 - \mathbf{R_2}^2) + \mathbf{y_2}^2}{2\mathbf{y_2}}$$

$$\mathbf{y_0} = \frac{(5^2 - 5^2) + 10^2}{2 * 10}$$

$$\mathbf{y_0} = \mathbf{5}$$

$$\mathbf{x_0} = \sqrt{\mathbf{R_1}^2 - \mathbf{y_o}^2}$$

$$\mathbf{x_0} = \sqrt{(5^2 - 5^2)}$$

$$\mathbf{x_0} = \mathbf{0}$$

So mathematically I get the Tag coordinate (0, 5)

Now I verify from Hardware model.

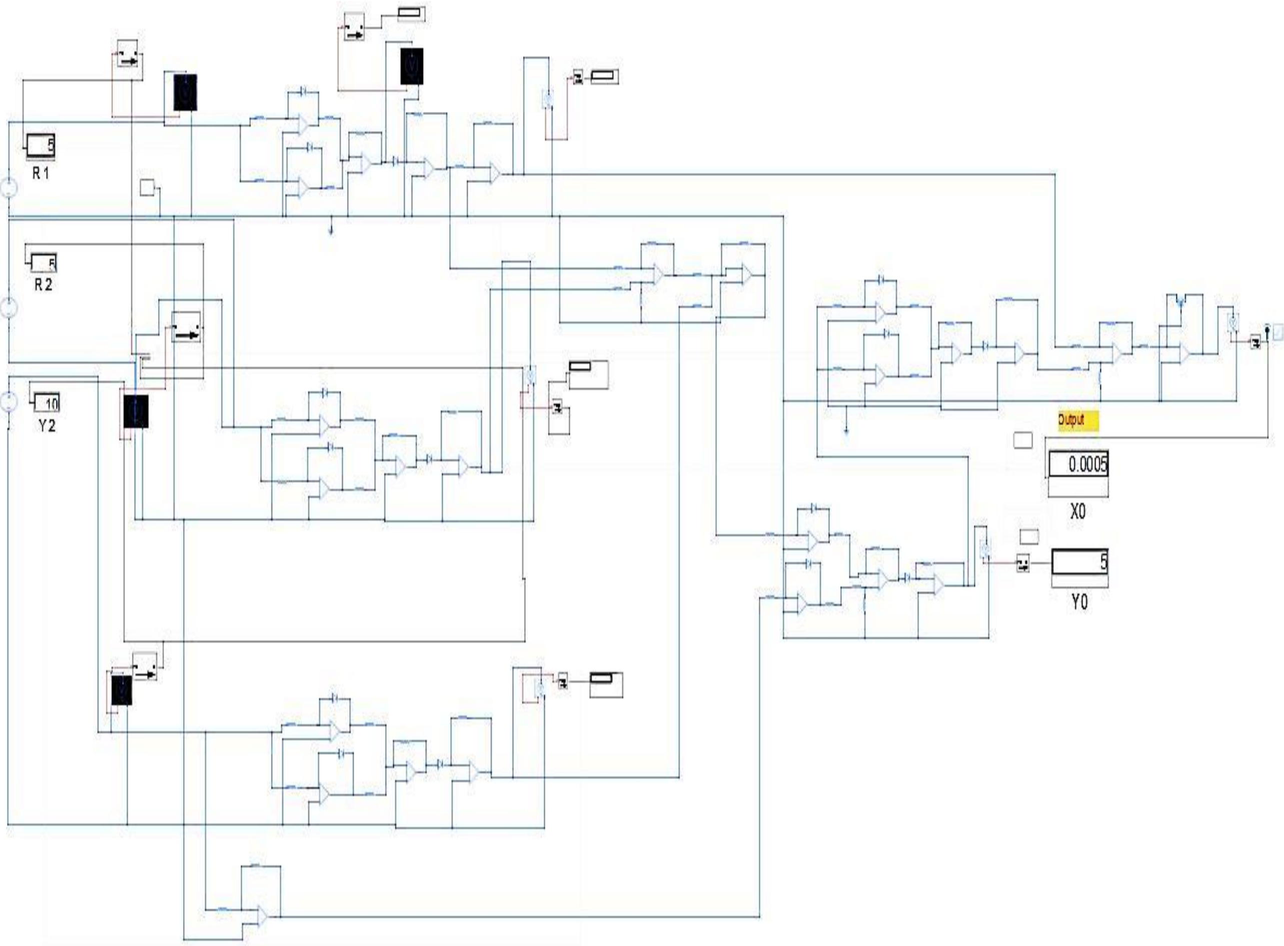


Fig-11 Output of Test-1

Tag Location Plot-1

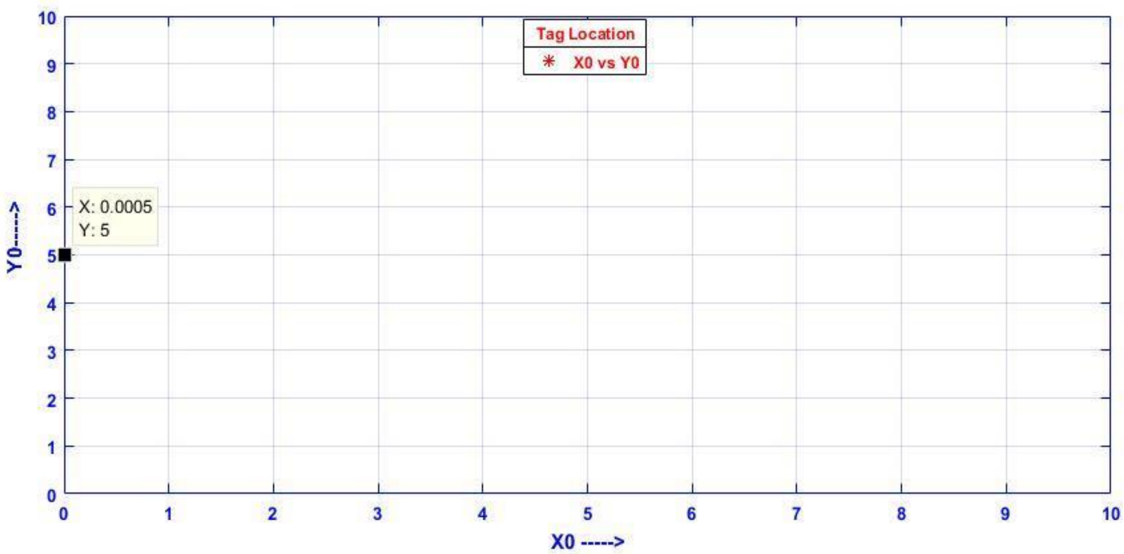


Fig-12

Comment: I get same result of Tag coordinate (0, 5), So mathematical data and experimental output data are matched.

2) Test-2:

Let, distance between two Readers, y_2= 10m

Tag distance from Reader-1, R_1=14.142m

Tag distance from Reader-2, R_2=10m

Putting this value in equation (V) & (VI), I get

$$\mathbf{y_0} = \frac{(\mathbf{R_1}^2 - \mathbf{R_2}^2) + \mathbf{y_2}^2}{\mathbf{2y_2}}$$

$$\mathbf{y_0} = \frac{(\mathbf{14.142^2 - 10^2}) + \mathbf{10^2}}{\mathbf{2*10}}$$

$$\mathbf{y_0 = 10}$$

$$\mathbf{x_0} = \sqrt{\mathbf{R_1}^2 - \mathbf{y_o}^2}$$

$$\mathbf{x_0} = \sqrt{(\mathbf{14.142^2 - 10^2})}$$

$$\mathbf{x_0 = 10}$$

So mathematically I get the Tag coordinate (10, 10)

Now I verify from Hardware model, I get same result of Tag coordinate (10, 10)

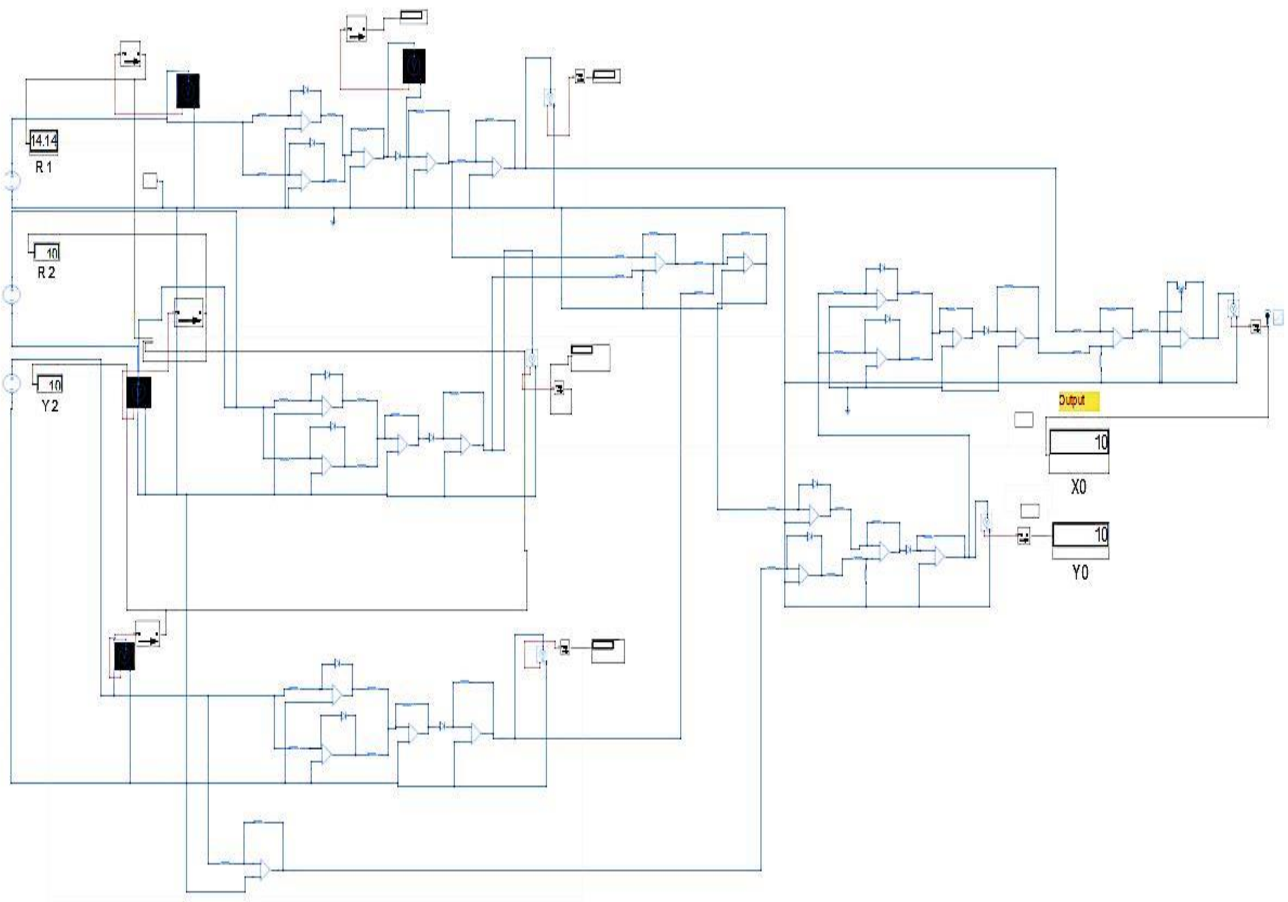


Fig-13 Output of Test-2

Tag Location Plot

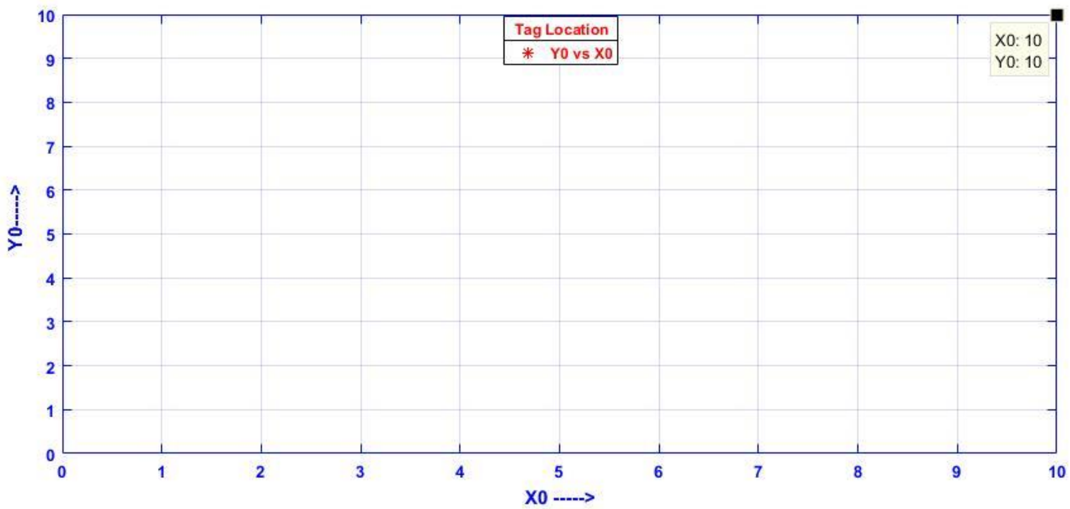


Fig-14

Comment: I get same result of Tag coordinate (10, 10), So mathematical data and experimental output data are matched.

3) Test-3:

Let, distance between two Readers, y_2= 10m

Tag distance from Reader-1, R_1=10m

Tag distance from Reader-2, R_2=14.142m

Putting this value in equation (V) & (VI), I get

$$\mathbf{y_0} = \frac{(\mathbf{R_1}^2 - \mathbf{R_2}^2) + \mathbf{y_2}^2}{\mathbf{2y_2}}$$

$$\mathbf{y_0} = \frac{(\mathbf{10^2 - 14.142^2}) + \mathbf{10^2}}{\mathbf{2*10}}$$

$$\mathbf{y_0 = 0.0001918 \approx 0.00}$$

$$\mathbf{x_0} = \sqrt{\mathbf{R_1}^2 - \mathbf{y_o}^2}$$

$$\mathbf{x_0} = \sqrt{\mathbf{10^2} - (\mathbf{14.142^2})}$$

$$\mathbf{x_0 = 10}$$

So mathematically I get the Tag coordinate (0, 10)

Now I verify from Hardware model, I get same result of Tag coordinate (0, 10)

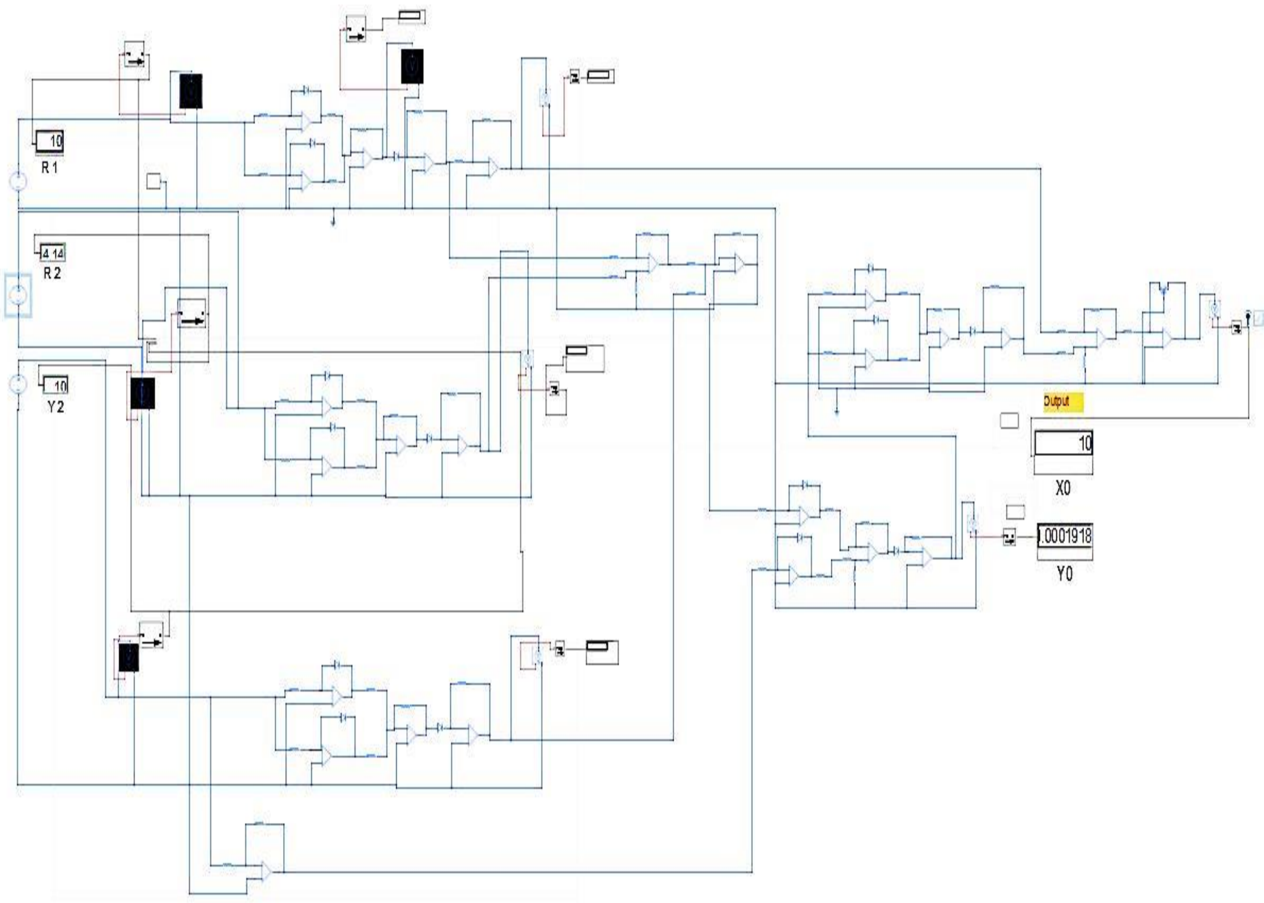


Fig-15 Output of Test-3

Tag Location Plot

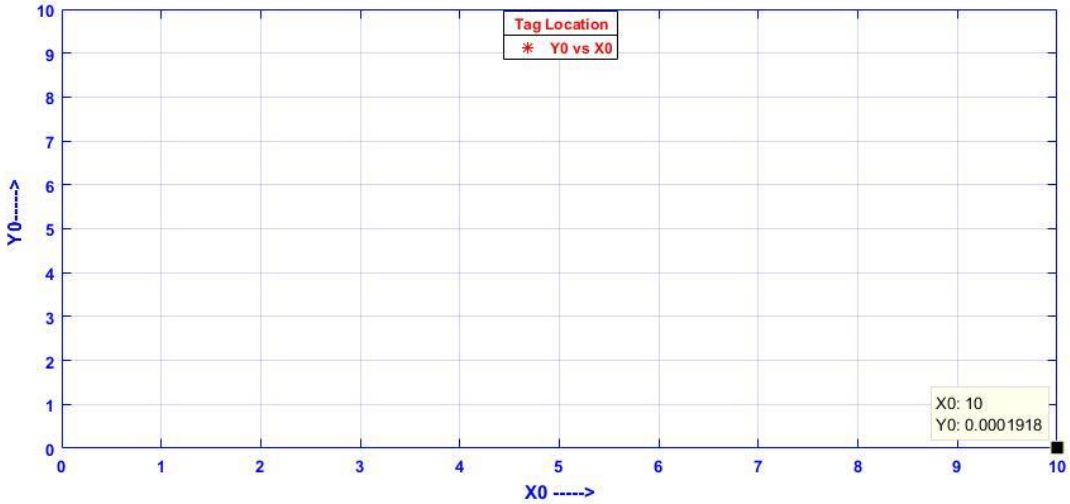


Fig-16

Comment: I get same result of Tag coordinate (0, 10), So mathematical data and experimental output data are matched.

4) Test-4:

Let, distance between two Readers, y_2= 10m

Tag distance from Reader-1, R_1=7.07m

Tag distance from Reader-2, R_2=7.07m

Putting this value in equation (V) & (VI), I get

$$\mathbf{y_0} = \frac{(\mathbf{R_1}^2 - \mathbf{R_2}^2) + \mathbf{y_2}^2}{2\mathbf{y_2}}$$

$$\mathbf{y_0} = \frac{(7.07^2 - 7.07^2) + 10^2}{2 * 10}$$

$$\mathbf{y_0} = 5$$

$$\mathbf{x_0} = \sqrt{\mathbf{R_1}^2 - \mathbf{y_o}^2}$$

$$\mathbf{x_0} = \sqrt{7.07^2 - 5^2}$$

$$\mathbf{x_0} = 4.99 \approx 5$$

So mathematically I get the Tag coordinate (5, 5)

Now I verify from Hardware model, I get same result of Tag coordinate (5, 5)

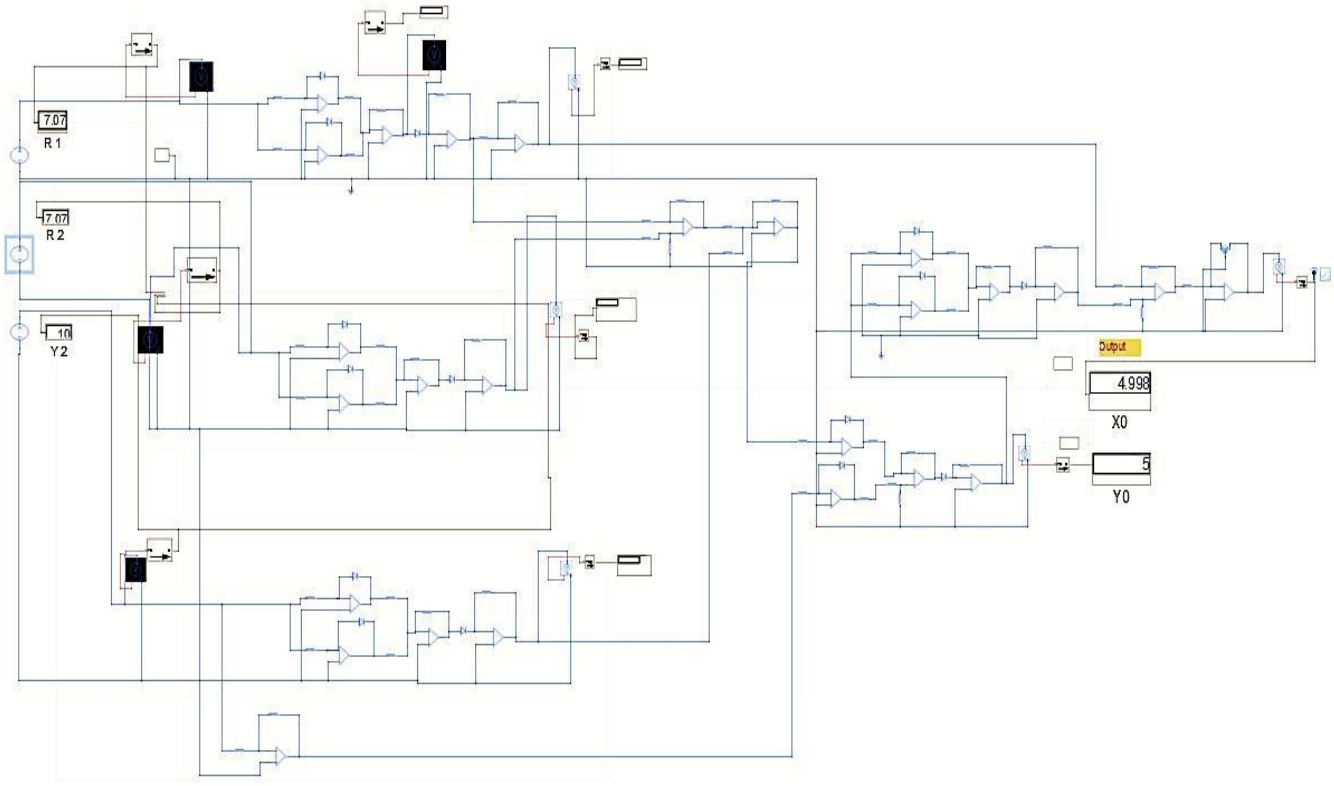


Fig-17 Output of Test-4

Tag Location Plot

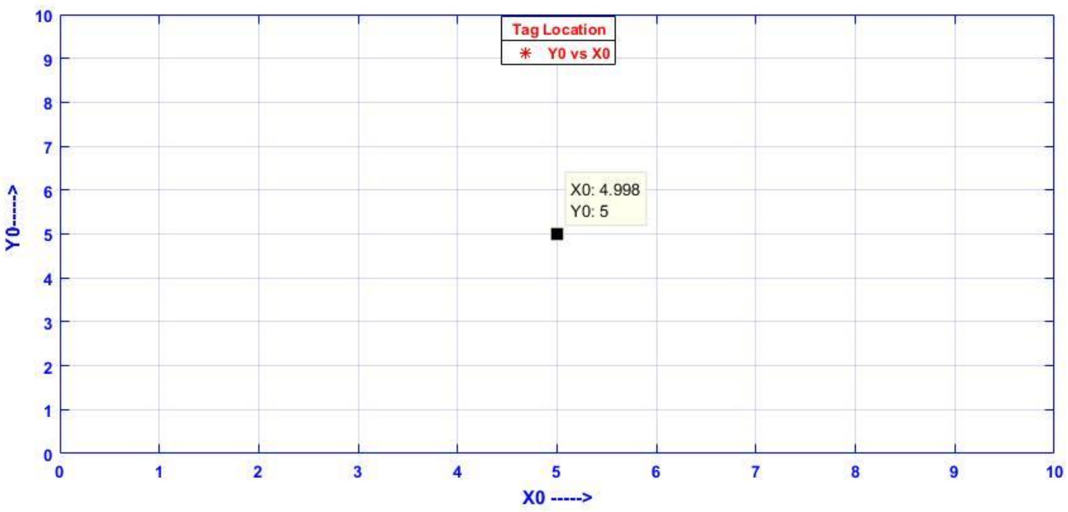


Fig-18

Comment: I get same result of Tag coordinate (5, 5), So mathematical data and experimental output data are matched.

From this four test, I can say that at every point, mathematical value and experimental output data are matched. So system is working fine with minimum error.

CHAPTER 5: Application of hardware model

Avian influenza refers to disease in birds caused by infection with avian (bird) influenza (flu) Type A viruses. These viruses occur naturally among wild aquatic birds worldwide and can infect domestic poultry and other bird and animal species. Infected birds can shed avian influenza A viruses in their saliva, nasal secretions, and faces. Avian influenza spreads meteorically among poultry birds and from birds to humans in contact through the movement of livestock and people, vehicles, cages, and equipment.

Due to its devastating consequences among the poultry industry and livestock farmers, Avian influenza has captured the attention of the international community over the years. Where outbreaks occur, it is often the policy to selectively slaughtering or stop poultry operations, to contain the spread of avian influenza. This represents heavy economic losses for farmers and a long-lasting impact on their livelihoods.

Due to the adverse effects of Avian influenza, it is the need of the hour to detect and separate the infected chickens from the flock at an early stage to curb the spread of this virus among the poultry flocks before it gets throughout the farm and endangers the livestock farmers both health wise and economically.

For this purpose, the published studies by Prof. Subir Kumar Sarkar and Subhashish Roy mentioned an RFID based system for early detection of Avian Influenza by monitoring few of the afore mentioned symptoms like feed intake behaviour, weight changes and lethargic behaviour of chickens.

My proposed system is used to track randomly moving chickens suspected to be infected by avian influenza virus based on parameters suggested in the paper by Subhashish Roy and Prof. Subir Kumar Sarkar in an indoor condition. The tracking of infected chicken is important order to locate their position in real time and separate them from the flock to curb the spread, so that the heavy economic losses can be avoided of farmers.

CHAPTER 6: Conclusion And Future Work

In this paper RFID based tracking algorithms is discussed along with a hardware model, which is used as references to determine the coordinates of Tag. It is acquired by locating the Tag and doing mathematical computations in coordinate geometry.

With this model we can track a chicken which is affected by avian influenza virus. For this purpose every chicken is tagged in cage, and readers are placed horizontally as per my prosed system. So any affected chicken is track by this hardware model as a result avian influenza can be tracked early and major financial loss can be avoided

Of course, there are still a few technical issues with the RFID location that need to be researched and fixed. For instance, further research would be necessary for three-dimensional location technology, RFID technology, and the fusion of things. RFID location technology is playing an increasingly significant part for several breakthrough technological bottlenecks in the new era of the new circumstance.

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