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Improvement in the security systems of AGV to prevent GPS spoofing

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Abstract

Autonomous Guided Vehicles (AGV's) are one of the critical enabling engineering marvel technologies of today, developed for manufacturing ease. They are used to do dangerous, and a few impossible works that cannot be done by humans. This paper will focus on the changes to be made in the Security systems of a GPS enabled Automated Guided Vehicle to prevent any kind of Data breaches or interferences in the GPS signals which could lead to a false signal location to the receiver, which is known as GPS spoofing, as well as Improvement in the *AI (ARTIFICIAL INTELLIGENCE)* making an autonomous guided vehicle a voice automated guided vehicle. As defined in the paper later that AGV's today are mostly track bound, which comes with its limitations. So, an AGV with a GPS-controlled motion will be able to move freely without any constraints, meaning more work could be done out of them. This paper works on this futuristic approach and its problems related to GPS spoofing which could lead to hazardous outcomes. And providing a voice-enabled microcontroller means ease of accessibility of this freely moving AGV doing its job just as an employee in a manufacturing plant.This paper aims to evoke discussion and elucidate the current research opportunities in the field of AGV's and to identify various problems in the security systems linked with an AGV and, suggest improvision.

***Keywords*:** Autonomous Guided Vehicles (AGV); AI (ARTIFICIAL INTELLIGENCE); Voice Automated Guided Vehicle; Data breaches; GPS spoofing

1. Introduction

The first autonomous guided vehicle arrived within the early 1950s and was nothing more than a truck, although it didn't need a driver or a rail system, navigating instead by following a track of wires embedded within the factory floor that generated a field. Wires gave a proper channel to move along the magnetic tape, optical strips, and eventually optical master steering and alternative additional subtle navigation systems. However, the job of the AGV remains the same: move large and heavy materials on an outlined route in a factory or warehouse. Automatic guided vehicles (AGV) are computer-controlled and wheel-based load carriers that travel the ground of a factory with no operator or driver. Their movement is directed by a mixture of code and sensor-based steering systems. As they move on a described path with precisely controlled acceleration and deacceleration or can move anywhere precisely with the intelligence of automatic obstacle detection through various scanners, AGV's provide safe movement of loads.

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A typical AGV will have the following capabilities: -

Transportation of Raw Materials, movement of finished goods in manufacturing plant, storage, and retrieval of goods, picking and delivering of products, etc.

Computerized guided vehicles boom efficiency and decrease fees by assisting to automate a production facility or warehouse. The AGV can tow objects and products within the again of them in trailers to which they will be able to autonomously be part. The trailers can be used to transport uncooked materials or finished products. The AGV also can shop objects on a mattress. The objects may be placed on a set of conveyors after which driven off through reversing them. A few AGV's use forklifts to raise items for storage. AGV's are hired in almost every industry, such as pulp, paper, metals, newspaper, and well-known production. Transporting substances together with meals, linen, or medicinal drug in hospitals is likewise accomplished.

AGV's international marketplace became worth USD 3.89 billion in 2018, and it's far anticipated to reach USD 10.00 billion with the aid of 2024 because the computerized guided car (AGV) market file states. In guide of this, observe that commercial programs are not the most effective feasible implementations of this generation: AGV's can also be involved in transporting luggage in airports, for help to disabled humans, for turning in food, water, and medication, for bomb and mine mapping, for retrieval and disposal of nuclear products in addition to for plant inspections and many other sports, making them extraordinarily flexible and flexible. Moreover, searching past the mere benefits practicable in phrases of performance, it turned into also confirmed that AGV's may additionally have an effect on sustainability through notably decreasing strength intake and dangerous emissions within business plants.

Fig.1-First Automated Guided Vehicle(AGV) by Barret Electronics [1].

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2. Literature Review

2.1 Introduction

The first AGV system become built and brought in 1953. It was a changed towing tractor that turned into used to tug a trailer and comply with an overhead wire in a grocery warehouse. The first big development for the AGV industry become the creation of a unit load automobile inside the mid-Seventies. This unit load AGV's won sizeable popularity within the fabric handling marketplace because of their capacity to serve several features. Given that then, AGV's have developed into complicated cloth managing transport automobiles starting from mail dealing with AGV's to exceptionally automatic automated trailer loading AGV's using laser and natural goal navigation technology. Developed with the aid of being Barrett Jr in 1954 (overhead twine to manual a modified towing truck pulley in a grocery warehouse) in 1973, Volvo evolved AGV to serve meeting structures for shifting vehicle bodies via its very last assembly flowers. Nowadays the AGV performs an important function within the design of recent factories and warehouses.

Kim et al. proposed impasse detection and prevention algorithms for AGV's. It was assumed that cars reserve grid blocks earlier to save you collisions and deadlocks among AGV's. A photo representation method, known as the "reservation graph," changed into proposed to express a reservation schedule in the sort of form that the opportunity of a deadlock can be easily detected. A technique to discover viable deadlocks by using the reservation graph became counseled.

Mehdi Yahyaei has designed an AGV the usage of fuzzy good judgment gadget and a rotational extremely-sonic sensor to steer the AGV to keep away from collisions and boundaries. He also hired a programmable logic manipulate (%) as the processor which makes the AGV be in the long run suit to the industrial environments. In the early nineties, fuzzy good judgment got here thru to control and manipulate the completion of the cloth drift in manufacturing floors. The principal indication of employing this device on AGV's turned into the ability to control more than one AGV in an equal time without collision. But, the best simulation effects are offered. Senoo et al used experimental outcomes of a three-wheeled mobile robotic to talk about the steadiness of a fuzzy controller. It is also said that fuzzy manipulate was implemented so that you can gain a discount of steer power, at the same time preserving better steer perspective whilst as compared with PI control.

The AGV real-time navigation function calls for the device to decide the next riding direction primarily based on the cutting-edge function of the AGV, which calls for excessive localization accuracy. Consequently, the right localization technique and approach have to be selected. In line with the real situation, a reliable and correct correction algorithm is applied to procedure the localization facts obtained by means of one-of-a-kind sensors, to reap correct localization coordinates and obtain the high-precision navigation desires of the AGV. The problems of AGV localization generation specifically include components: first, the steerage technology. For complex environmental elements, the localization accuracy varies from one-of-a-kind guidance technologies. The second element is information fusion generation. The technique is tedious when fusing the facts collected by sensors with special accuracy.

The localization of the AGV committed to the state-of-the-art is slam. It may help the AGV to build an indoor surroundings map for the absolutely unknown indoor surroundings through center sensors which include LIDAR, and realize the self-sustaining navigation of the AGV. The SLAM era particularly includes visible slam (VSLAM) and LIDAR SLAM. VSLAM refers to navigation with depth cameras consisting of the Kinect in

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indoor environments. Its working precept is to optically method the environment across the AGV. The cameras collect image facts and the processor links the collected image records to the real role of the AGV, which completes the self-sustaining navigation and localization of the AGV. VSLAM continues to be within the studies degree, a ways from the extent of practical utility. On the excellent hand, the quantity of calculation is simply too large, and the performance necessities of the AGV tool are excessive. Alternatively, maps generated via VSLAM are factor clouds, usually, which can't be applied for the course-making plans of the AGV. LIDAR SLAM refers to using LIDAR as a sensor to test the encircling environment in real-time.

The processor calculates the gap between AGV and surrounding gadgets and objects, which achieves synchronous localization and actual-time map advent. The LIDAR has excessive scanning accuracy and rugged directivity. The computation of the strolling application program is small throughout the development of the map and localization, and it may well adapt to indoor environmental situations. However, the charge of LIDAR is immoderate, and the charge is among tens of loads to masses of hundreds.

2.2 Navigation Techniques

There are so many types of navigation available for computerized guided motors consisting of Wired, Guide tape, Laser target navigation, Vision guidance, Geo guidance, and so forth. In beyond few years a few other approaches were additionally adapted as navigation techniques. Maximum of the time navigation approach choice relies upon the mission that wishes to be accomplished in the available environment. These days a commonplace navigation technique used in carrier business environment is guide tape and imaginative and prescient guidance. Out of these navigation strategies, some are explained.

2.2.1 Wired Navigation

A slot is cut into the floor on which AGV wants to transport. In this cut, a cord is placed around 1 inch or at a measurable distance beneath the floor in a way that microcontroller can easily get interfaced with it. This slot is cut precisely in a way that AGV will follow. A radio (any measurable) signal is used to transmit records via this wire. according to the facts received AGV movements in a facility. A sensor that can detect the relative function of these alerts is the vicinity on the lowest of the AGV.

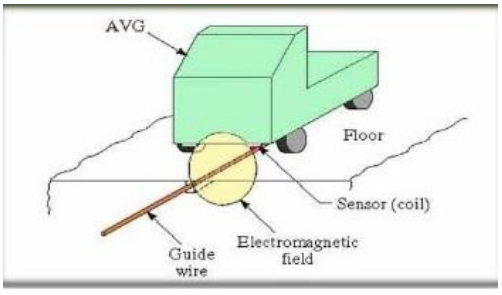

Fig.2- Wired Navigation. (Image taken from Slideshare).[2]

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2.2.2 Guide Tape Navigation

As names, this navigation technique calls for tape on the floor as the direction of AGV to navigate inside the facility. This tape can both be colored or magnetic. The sensors hooked up in AGV will detect this line and send a signal to the control gadget. Consistent with operation requirements and common sense programming this AGVmovements within the facility. There are other manners to navigate the usage of the line following method which includes double line following at a time for unique movement. Making marks with these lines as the station begins and forestall is also a probable manner of navigation.

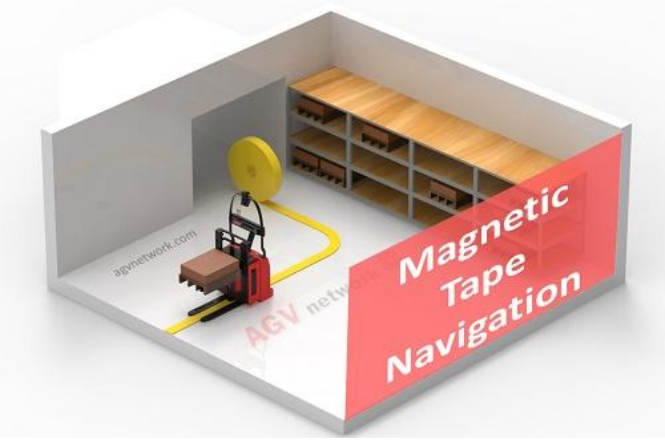

Fig.3-Magnetic Tape Navigation.[3]

2.2.3 Laser Target Navigation

For laser goal navigation the automatic guided automobiles include a laser transmitter and receiver on the front facet or each aspect of it. The laser is transmitted and the reflection is obtained with the aid of the identical sensor. According to the sign obtained from this sensor microcontroller actions automobiles or top movers for AGV movement in the discipline. Such sort of navigation is beneficial while operation like underground mining required or locations in which GPS or different system of navigation doesn't work nicely.

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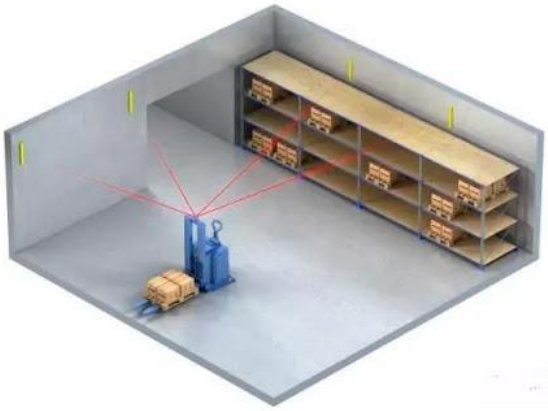

Fig.5- Laser Guidance Navigation Technique.[5]

2.2.4 Vision Guidance Navigation

Imaginative and prescient-based navigation is carried out through both the help of digital cameras mounted on AGV or sensors like image sensors. On this navigation approach, synthetic intelligence is set up on top of things system for receiving information from digital cameras analyzing the data and pass automobiles from outcomes of facts. Equal navigation can be finished with the use of PC imaginative and prescient with the neural network. The alternative use of this navigation is to navigate in step with color.

Fig.4-Vision Guidance Navigation System.[4]

2.2.5 Other Navigation Techniques

There are different methods of navigation as opposed to these techniques. Inclusive of self-reliant navigation that is performed with the aid of incorporating an excessive degree of on-board autonomy and by decreasing the number of manual paintings required that establishes the a priori information of the environment. Encoder

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primarily based navigation that is performed through encoder connected with cars of AGV and tiles which can be being accompanied via AGV. Magnet spot guidance method-this is archived with the magnetic spot at stations and hall impact sensors on AGV. All of these navigation methods have been illustrated and explained above. Various researches are going on the navigation techniques. Just following these things, we are improvising the AGV with GPS spoofing and voice-controlled AGV.

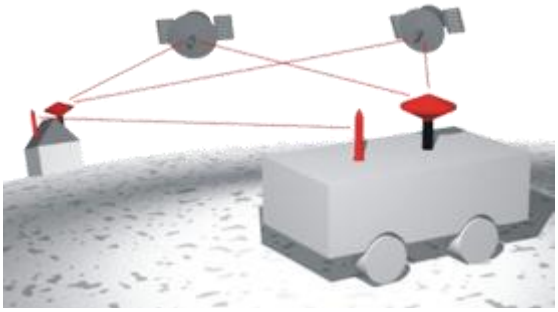

Fig.6- Satellite Navigation Method.[6]

3. Research Methodology

3.1 GPS Spoofing

GPS spoofing is an assault wherein a radio transmitter placed near the goal is used to interfere with a legitimate GPS signal. The attacker can transmit no facts at all or ought to transmit inaccurate coordinates. The U.S.-operated worldwide positioning machine (GPS) is simply one of the international's global navigation satellite structures (GNSS). Others include Russia's GLONASS, China's Bei Dou Navigation Satellite Gadget, and the European Union's Galileo.

GNSS is also used for correct timing, and attackers can intrude with that feature. As an example, in March, on the Geneva motor show in Switzerland, an assault from an unknown source affected the GPS structures of Audi, Peugeot, Renault, Rolls-Royce, Volkswagen, Daimler-Benz, and BMW vehicles. In preference to showing the correct vicinity, the automobiles have been reporting that they have been in Buckingham, England, within the 12 months of 2036.
GPS spoofing is likewise used to refer to smartphone applications that may have an effect on a smartphone's place information, as well as to cyber-assaults against networked structures that rely on GPS statistics.

3.2 How to protect against GPS Spoofing?

Within the safety vicinity (defense sector), wherein GPS spoofing has been a possibility from the start, there are encrypted variations of the machine. n transportation and logistics, there are backup structures, such as ground-based navigation beacons and paper charts.
For many other industrial applications, the military-grade encrypted structures aren't a choice and it can be hard

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to find a realistic opportunity to GNSS. The trouble is the handiest going to get worse. There are actually 6 billion GNSS sensors in use in gadgets, in line with a current file via the EU worldwide navigation satellite systems corporation. That quantity is expected to reach 8 billion by 2023.

There's a new era of navigation satellites at the horizon that are designed to be extra comfortable, says Demeo, COO at Virsec Systems, a cybersecurity company. "however, it's no longer something that can be constant overnight." until then, other satellite systems structures can provide location data, though not as it should be as GNSS, in addition to different location structures, consisting of cell Cellphone Towers. For digital threats, along with GPS spoofing apps or cyber-attacks, companies ought to appoint basic cyber-security concepts to guard their systems. Similarly, as with Uber, device mastering and other analytics may be used to hit upon suspicious person conduct. For radio-based assaults, groups can function their antennas so that they're less likely to pick up floor-based totally indicators and to region them where they can't be visible to the public. The department of fatherland safety (DHS) additionally recommends that organizations use replica antennas, including on opposite ends of construction or ship. "You may additionally set up a blockading antenna that blocks any signals which can be fraudulent or can motive interference," says Van Riper.

We, however in our project uses the same technology for rectifying the signals and detecting them, and treating them as false signals. We made a circuit as shown in figure 7. We proposed this approach in rectifying and filtering the signals to prevent the system from cyberattacks and data breaches. The circuit along with the parts and controllers is shown below. In Table 1, there is the key for the parts shown in the figure.

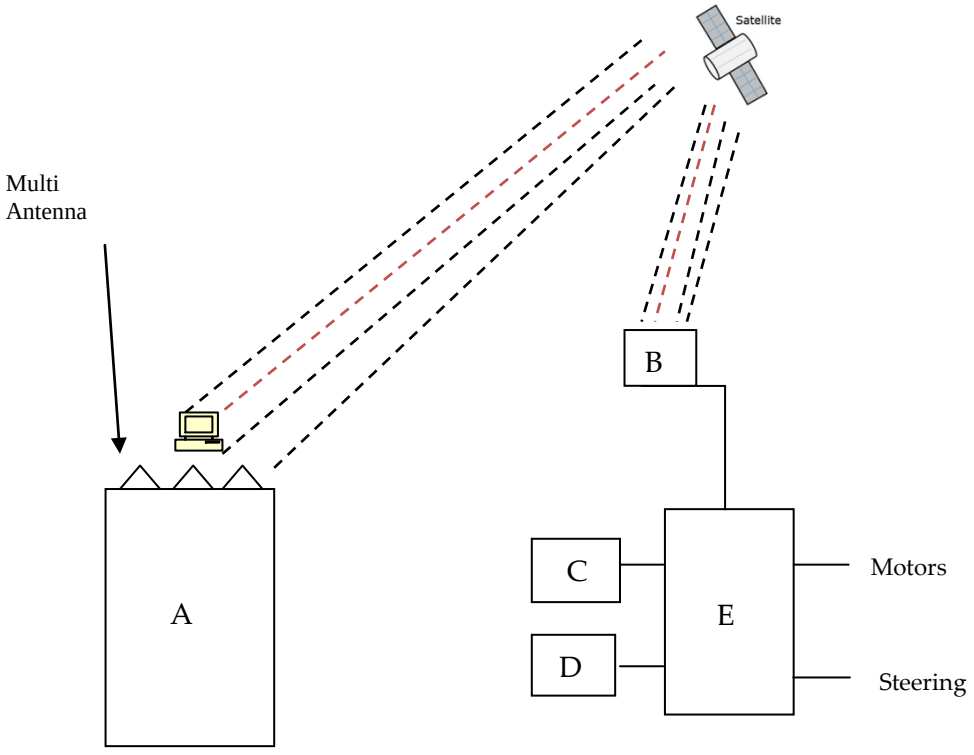

Fig.7- Circuit Diagram of our approach.

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Key:-

A - GPS Signal Transmitter with Multi-antenna
B - GPS Receiver with Signal Rectifier
C- Voice Modulator
D - Other Sensors
E – Micro-controller/ECU (AI)

Table 1- Key for the parts shown above.

The parts, sensors, modulator, and micro-controller shown in the proposed diagram are explained here.
In the diagram, A device is a GPS signal transmitter with a multi-antenna. This device transfer the signals to the satellite as shown by the black dotted lines in the diagram.
(refer to Fig.7). GPS indicators are broadcast through Global Positioning System satellites to enable satellite navigation. Receivers on or close to the earth's surface can decide location, time, and pace using these facts.

The device with named B refers to the GPS Receiver with a signal rectifier. This device rectifies the signals by matching each signal so that any discrepancy or GPS-spoofed content gets rectify. The C in the diagram is a Voice Modulator for the conversion of conventional AGV to a voice-recognized AGV. This modulator listens to the advice of the person to convert the signal to digitalized signal which is fed to the AI in a microcontroller or ECU. Other sensors are also employed in the project for the proper and easy handling of the AGV. The device E is a micro-controller or we can call ECU(Electric Control Unit). A typical microcontroller (FATEC Santo Andre ECU board) which was used in the research "Mockup Didactic Set for Students Development in Automotive Electronic" by F.S. Albaladejo with parts highlighted is shown in figure 8. For more information refer to the research paper by F.S Albaladejo.

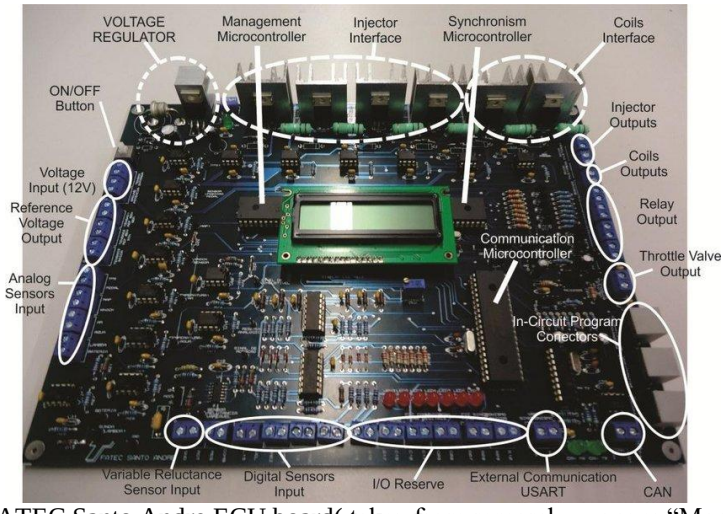

Fig. 8- The FATEC Santo Andre ECU board(taken from research paper "Mockup Didactic Set for Students Development in Automotive Electronic by F. S. Albaladejo.)

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3.3 Our objective

- Improvement in the security systems to help to prevent ***DATA BREACHES*** which are likely to happen, as a lot of sensors and wireless connectivity is allowed. GPS is a highly accurate sensor and satellite is involved, so any fake location and interference (GPS SPOOFING) can be incurred with the original signal. Also, it allows anyone to know the exact Real-time location making anyone vulnerable to any kind of attack or theft in the case of automated security vans or cash-carrying vans.
- Improvement in the ***AI (ARTIFICIAL INTELLIGENCE)***making an autonomous vehicle a voice automated guided vehicle. Linking an automated guided vehicles AI to voice-assisted AI, making it more intelligent by letting the user operate various security functions like child lock, locking and opening of the doors, dictating faults, etc.

The process starts with the GPS Transmitter which sends the signals to the receiver end and is transmitted to the micro-controller or ECU. When we transmit or send multiple signals instead of one signal that is different versions of the same signal. Various Antennas will send the different signals to the satellite and it will now be reflected and received at GPS Receiver attached with rectifier.

In-circuit diagram (figure 7) the signals sent by the transmitter are shown with black dotted lines and a red dotted line. This red dotted line in the diagram is a false signal which is been attached by some hacker to the system. The satellite will bounce back these signals to the receiver end. This receiver is incorporated with a rectifier which will rectify the signal. The false signal which is attached by the hacker during GPS spoofing will get denied at B's end which is at the receiver end after compiling and calculating with the other signals transmitted.

Now, all purely rectified signals will enter the Micro-Controller and the functions will get perform without hacking and GPS spoofing.

Our first objective will be completed by this above process. The micro-controller will send the signals to the motors and steering for guiding and navigating our AGV.

The second will be assured with the use of Voice-Modulator which will convert the audio signal to the digital signal and will send these signals to the ECU and the working and handling of AGV will start. This is the way by which we can produce a better and AI-based AGV with voice recognition.

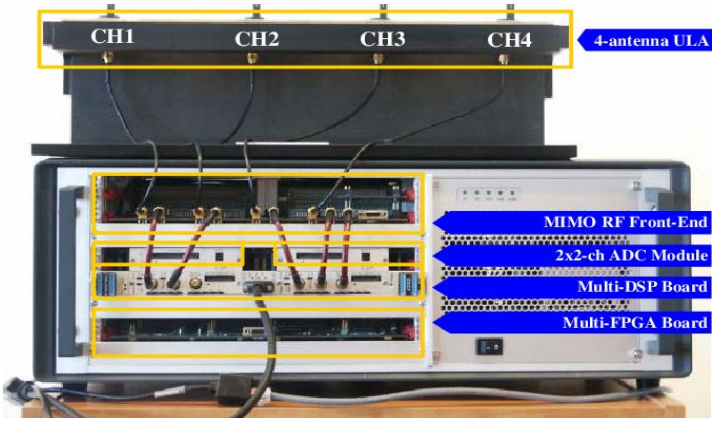

Fig. 8- Multi-Antenna Dual-band Receiver setup.[7]

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3.4 Key Technological Areas

- **Artificial Intelligence (AI)** – For the AGV to operate in a full range of environments with millions of changing aspects that will need to be accounted for, the AI constitutes the self-learning capabilities will able to grasp the surroundings.
- **GPS**– These global positioning systems will be a critical link for AGV to determine their location as they move.
- **Dedicated short-range communications (DSRC) –** The ability for vehicles to communicate with each other ("vehicle-to-vehicle" or "V2V") and infrastructure ("vehicle-to-infrastructure" or "V2I").
- **LIDAR** – LIDAR is a system like a RADAR that emit laser in densely-spaced increments and discrete way. The reflected laser light is like RADAR and is used to provide the AGV information on the distance for each object on which the laser is reflected.

Now discussing the various researches we here presented the table of various related researches with the title and authors mentioned in separate columns along with the journal and publication year in other columns. The summary table is shown in the next subsection of the third section.

3.5 Summary of papers

S.No	Title	Authors	Summary	Journal	Year
1.	Design and Development of an Automated Guided Vehicle	Georgios Kaloutsakis Nikos Tsourveloudis	This paper gives the development of the AGV -*Hellenak* that is manufactured at the Machine Tools Laboratory of the The Technical University of Crete in Greece.	Research Gate	2004

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2.	Economic evaluation of automated guided vehicles usage in a food company	Letizia Tebaldi, Giulio Di Maria, Andrea Volpi, Roberto Montanari, Eleonora Bottani	This paper draws the economic analysis for implementing AGV technology.	ScienceDirect	2021
3.	Design of Voice Controlled Automated Guided Vehicle	Sreenivas H T Arjun C	They design the AGV with voice-controlled recognition.	Research Gate(IJSTE)	2017
4.	Connected and autonomous vehicles: A cyber-risk classification framework	Barry Sheehan, Finbarr Murphy, Martin Mullins, Cian Ryan	This approach makes use of a Bayesian Community (BN) model, premised at the variables and causal relationships derived from the Commonplace vulnerability scoring scheme (CVSS), to represent the probabilistic structure and parameterization of CAV cyber-danger	Elsevier	2019
5.	AGV Localization System Based on Ultra-Wideband and Vision Guidance	Xiaohao Hu Zai Luo Wensong Jiang	Aiming at the problems of low localization accuracy and complicated localization techniques AGV in the contemporary computerized storage and transportation procedure, a mixed localization method primarily based on the UWB and the visual steering is proposed.	Research Gate	2020

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6.	A Research on Locating AGV via RSS Signals	Nguyen Duy Anh Huynh Minh Khoi	This paper proposed a technique- A good way to recognize AGV and the distance among them is through the received signal energy indicator (RSSI) technique.	Research Gate	2019
7.	A cost-effective GPS-aided autonomous guided vehicle for global path planning	Gorgees S. Akhshirsh, Nawzad K. Al-Salihi, Oussama H. Hamid	This paper proposes the robotic platform for global path planning of a GPS-aided AGV.	Scopus	2020
8.	A New GNSS Spoofing Detection Method Using Two Antennas	Jiajia Chen Ying Xu Hong Yuan Yige Yuan	This paper proposes a new GNSS spoofing detection method using only two off-the-shelf antennas	IEEE	2020
9.	The Age of Agile Manufacturing	Brian Maskell	Examines the improvement of agile manufacturing and explores the important thing success elements: consumer prosperity, people and facts, co-operation inside and between corporations, and fitting an enterprise for trade.	Research Gate	2001

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10.	Scheduling and routing of automated guided vehicles: A hybrid approach	Ayoub InsaCorréa André Langevin Louis-Martin Rousseau	This paper proposes a hybrid method designed for solving the problem of dispatching and freely routing automated guided vehicles (AGV's) in FMS.	Research Gate	2007
11.	Increase in Efficiency using PID Control of an Automated Guided Vehicle For Product Warehouse	Suman KUMAR Das	This paper affords an automated AGV transportation solution that meets the necessities of automating the packing and transportation of gadgets from shelves.	Research Gate	2016
12.	Mockup Didactic Set for Students Development in Automotive Electronic	F. S. Albaladejo	This paper gives the students the ability to have hands-on experience with an engine with a didactic approach	Research Gate	2013
13.	Smart Sensors Applications for a New Paradigm of a Production Line	Marina Indri	This paper calculates 3 different aspects of this commercial renewing technique, based on 3 distinct opportunities of exploiting sensors, toward a new paradigm of a production line	Semantic Scholar	2019
14.	Automated Guided Vehicle System (AGV'S)	Sushant S. Pati	This paper presents the research review study of AGV'S technologies.	IRJET	2020
15.	Automated Guided Vehicle System	AroonDass. P, Rakesh. S	This paper illustrates the designing and installing AGV systems in FMS	IRJET	2019
16.	Automated Guided	Lothar Schulze,	This paper points out		

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	Vehicle Systems: a Driver for Increased Business Performance	Sebastian Behling, and Stefan Buhrs	the technological updation of the AGV'STechhnology.	IMECS	2008
17.	Human-Robot Interaction: A survey	M. A.Goodrich, A. Schultz	This review paper presents a unified treatment of HRI problems, to specify the themes and discuss challenges.	Semantic Scholar	2007
18.	Scheduler and voice recognition on home automation control system	SyarifHidayat Syahrial Farid Firmanda	This paper proposes an automated home with seamless communication along with voice command technology	IEEE	2015
19.	Smart automated guided vehicles for manufacturing in the context of Industry 4.0	JasprabhjitMehami MauludinNawi Ray Y. Zhong	This paper demonstrates AGV's in a real-time scenario that uses the RFID tags for motion control and identification purpose.	ELSEVIER	2018
20.	Energy Shaping Control for Wireless Power Transfer System in Automatic Guided Vehicles	Wenjie Chen Jia Liu Si Chen Liyan Zhang	This paper gives the idea of proposing an energy shaping controller for the AGV's wireless transmission and wireless power transfer.	Research Gate	2020
21.	The internet of things for smart manufacturing: A review	Hui Yang Soundar Kumara Satish T.S. Bukkapatnam Fugee Tsung	This article gives a review of the IoT technologies and processes that are the foundations of data-driven innovations in smart manufacturing.	Taylors & Francis	2018
22.	Wireless requirements and challenges in	Varghese D. Tandu	This paper discusses the various wireless challenges for implementing this AI	IEEE	2014

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	Industry 4.0		technology to the Industry 4.0		
23.	Smart manufacturing: past research, present findings, and future directions	Kang HS	This article surveyed and analyzed the things and findings related to smart Manufacturing starting from the past to present and present to future.	Springer Link	2016
24.	Navigation and docking manoeuvres of mobile robots in industrial environments	H. Roth K. Schilling	This paper addresses the mixture of size signals of easy CCD-cameras, Odometry, and Ultrasonic sensors.	IEEE	2002
25.	A Review of Recent Advances in Automated Guided Vehicle Technologies: Integration Challenges and Research Areas for 5G-Based Smart Manufacturing Apps	EMMANUEL A. OYEKANLU ALEXANDER C. SMITH	A review of recent AGV's and AMRs is presented along with the 5G based Smart Manufacturing	IEEE	2020

3.5 Motivation:

- GPS spoofing is an attempt to deceive a GPS receiver by providing a fake GPS signal from the ground.
- GPS spoofing can be used to hijack AGV's and cars, or confuse drivers, drones, etc., and can cause considerable damage.
- GPS spoofing tools are affordable and are easily available.
- Anti-GPS spoofing technologies are being developed, but mainly for large systems, such as maritime navigation.
- Voice automation allows us to operate the vehicle and AGV's with more ease and comfort and can

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prove to be the next step in the advancement of AGV's.

- AI with Voice recognition has the advantage of operating the AGV with more precision.

4. Results and Findings

As, GPS (Global positioning system) is a device that sends the signal to a satellite roaming in space, which then sends it back to a receiver. As there is a satellite involved a lot of interference can be added and a false location can also be given, making it worse.
This is known as GPS Spoofing and a lot of research is going on and various technologies are being developed which are known as Anti-GPS spoofing technologies like Multiantenna receiver configurations (2×2) and beamforming technology, GPS firewall, etc. While AGV's are massive and powerful machines interference and a false signal will lead to the same fatal outcomes. So, it is a necessity to add this Anti-GPS spoofing technology to the AGV's.

Anti-GPS Spoofing technologies being developed that can be used: -

- Use of Multiantenna receiver configurations (2×2) and beamforming technology: - This technology is being developed for big GPS devices. The technology improves the signal strength and clarity in the interference while protecting against the GPS- Spoofing as the idea of the multiple antenna diversity is to provide the receiver with multiple signals of the same kind through independent channels. On the other hand, the use of multiple independent signals will allow us to improve the quality of the sent signal as they are sent individually and
- GPS Firewall: - The idea is to provide a firewall between the receiver and the sent signal from the satellite to remove any discrepancies and interferences in the signal provided.

Voice-activated Automated Guided Vehicle:

The idea behind this is to fit a voice modulator with the microcontroller of the system which will allow the user to communicate with the machine through the voice modulator. Then the microcontroller is programmed into identifying and sending signals to the motors or the driving system of the AGV The microcontroller will understand the signal sent by the voice modulator and by communicating with the LIDAR and GPS scanner will operate and move accordingly.

Future Scope:

This paper is all about advancement in the AGV's in their operations and securities.

- GPS spoofing can be fatal if it comes to controlling the traffic and confusing a heavy machine which can be a case putting many lives in danger. So, making GPS a secure network, contributing to Anti-GPS spoofing technology, and bringing this to AGV's will become a necessity in the future.
- Programming an AGV's AI with voice automation allows it to move with the least effort making it more versatile. Therefore, in the future, these voice AGV's can replace existing AGV's for ease of access and versatility.

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Limitations:

With advancement, there come limitations too. Some of them are stated below:

- Developing and adding Anti-GPS spoofing technologies can be very costly.
- Adding Anti-GPS spoofing technology will not be easy, as there are many sensors involved, and adding a firewall can disrupt their signals as well making it difficult to interpret for the AI.
- Till now there are no accurate voice AI which can be given full control over an AGV as sometimes, the already developed AI's can interpret wrong commands or, the commands given unintentionally while having a conversation can result in dangerous outcomes.

5. Conclusion

As the global positioning systems (GPS) will be a critical link for AGV to determine their location as they move, but also impose a threat to privacy to the person sitting inside the vehicle or operating one like GPS spoofing, as the position of the person can be known from anywhere and anytime. So, to keep the position of the person secret to itself we need to make the communication between the GPS and the vehicle more secure by using GPS firewalls which are being used for large GPS receivers and devices, or by using multi-antenna receiver configurations (2×2) and beamforming technology.

Voice automation allows us to operate the vehicle and AGV's with more ease and comfort. They can prove to be the next step in the advancement of AGV's. AI with Voice recognition has the advantage of operating the AGV with more precision and decrease in error as the commands programmed in the systems are the accurate ones and can allow the task to be operated with accuracy.

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