

ICETI 2024

# BOOK OF PROCEEDINGS

OCTOBER 02-06 2024

8TH INTERNATIONAL  
CONFERENCE ON  
ENGINEERING TECHNOLOGY  
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*On behalf of the organizing committee, we are pleased to announce that the International Conference On Engineering Technology And Innovation is held on October 02-06, 2024 in Sarajevo, Bosnia and Herzegovina. ICETI 2024 provides an ideal academic platform for researchers to present the latest research findings and describe emerging technologies, and directions in Engineering Technology And Innovation. The conference seeks to contribute to presenting novel research results in all aspects of Engineering Technology And Innovation. The conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Engineering Technology And Innovation. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in all areas of Engineering Technology And Innovation. The conference will bring together leading academic scientists, researchers and scholars in the domain of interest from around the world. ICETI 2024 is the oncoming event of the successful conference series focusing on Engineering Technology And Innovation. The International Conference on Engineering Technology and Innovation (ICETI 2024) aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of Engineering Technology and Innovation. It also provides the premier interdisciplinary forum for scientists, engineers, and practitioners to present their latest research results, ideas, developments, and applications in all areas of Engineering Technology and Innovation. The conference will bring together leading academic scientists, researchers and scholars in the domain of interest from around the world. The conference's goals are to provide a scientific forum for all international prestige scholars around the world and enable the interactive exchange of state-of-the-art knowledge. The conference will focus on evidence-based benefits proven in technology and innovation and engineering experiments.*

*Best regards,*

*Prof. Dr. Özer ÇINAR*



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## ENCRYPTED MESSAGING APPLICATION COMBINING ADVANCED ENCRYPTION STANDARD AND RIVEST, SHAMIR, ADLEMAN ALGORITHMS

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### Abstract:

Instant messaging applications have become an essential part of modern communication, driven by widespread smartphone usage. These applications facilitate the rapid exchange of messages, photos, and videos but also raise significant concerns about personal data security and privacy. This study addresses these concerns by developing a secure, end-to-end encrypted messaging application that combines Advanced Encryption Standard (AES) and Rivest–Shamir–Adleman (RSA) algorithms. The application, built using Flutter, ensures that messages are encrypted and stored securely in Firebase Firestore, with real-time communication facilitated through a Node.js server and ngrok for secure deployment. Individual messages are encrypted using RSA, while group messages employ AES for efficient and secure encryption. By integrating socket communication with robust encryption techniques, this application provides a novel approach to secure digital communication, ensuring that messages are accessible only to the sender and recipient, thereby safeguarding user privacy and data integrity. The findings underscore the importance of end-to-end encryption in modern messaging platforms, highlighting the innovative combination of RSA and AES in enhancing communication security.

**Keywords:** End-to-End Encryption, Personal Data Security, Cryptography, RSA, Socket, Secure, Secure Data Storage, Secure Instant Messaging



## PREDICTION OF DISEASE-RELATED MIRNAS USING LABEL PROPAGATION METHOD

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### Abstract:

Non-coding RNAs (ncRNAs) are divided into two groups based on their nucleotide length: non-coding RNAs (lncRNAs), which are longer than 200 nucleotides, and microRNAs (miRNAs), which are approximately 20-25 nucleotides long. Studies have shown that miRNAs play a crucial role in complex human diseases, particularly cancer. Identifying disease-associated miRNAs is essential, as they can serve as biomarkers for various conditions. However, due to the extensive and costly nature of experimental studies, computational methods have been developed. This research utilized the Label Propagation method to uncover disease-associated miRNAs by considering known miRNA-disease associations, functional similarities of miRNAs, semantic similarities of diseases, Gaussian Interactions Profiles of miRNAs, and Gaussian Interactions Profiles of diseases. The performance of the model was evaluated using leave one-out cross-validation (LOOCV) technique and 5-fold cross-validation technique. A case study on breast cancer was also conducted. The results demonstrated that the Label Propagation method could effectively identify disease-associated miRNAs.

**Keywords:** miRNA, disease, miRNA-disease association, Label Propagation



## UNCOVERING DISEASE-RELATED MIRNAS WITH COMPUTATIONAL TECHNIQUE

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### Abstract:

MicroRNAs (miRNAs) are a type of non-coding RNA that typically consists of around 20 nucleotides. Developments in biotechnology and bioinformatics have revealed that miRNAs play a significant role in complex human diseases. Studies have shown that certain miRNA expression levels are consistently upregulated in tissue-specific cancer types such as colorectal, leukemia, lymphoma, pancreatic cancer, prostate cancer, breast cancer, ovarian cancer, gastric cancer, colon cancer, and lung cancer. Therefore, identifying miRNAs associated with diseases is of great importance for early diagnosis and treatment. However, identifying disease-associated miRNAs through experimental methods is quite costly. Therefore, computational approaches have been developed to uncover these associations. This study utilized experimentally verified human miRNA-disease connections, semantic similarities between diseases, and functional similarities of miRNAs in a calculation method. The results were evaluated with ROC curves plotted and AUC values calculated using the 5-fold cross-validation technique and the leave one-out cross-validation (LOOCV) technique. Overall, the computational technique we used successfully identified potential disease-associated miRNAs.

**Keywords:** miRNA, disease, miRNA-disease relationships, ROC, AUC



## EFFECT OF TMAB AND CR3C2 CONCENTRATION ON SURFACE HARDNESS OF NI-B/CR3C2 COMPOSITE ELECTRODEPOSITION

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### Abstract:

The coating process constitutes an important part of developing materials science. In cases where the basic properties of the metal materials most commonly used in sectors meet the needs of the sector but cannot meet the surface quality requirements, these processes are resorted to by industries. Electroplating is the most widely used and efficient coating process for these metal materials. In this study, Ni-B/Cr<sub>3</sub>C<sub>2</sub> nanocomposite coating was obtained on ST-37 steel using DC. While 3 different current densities (50, 75, 100 mA/cm<sup>2</sup>), 3 different TMAB contents (3, 6, 9 g/l), and 3 different Cr<sub>3</sub>C<sub>2</sub> contents (1, 3, 5 g/l) were used in the research, the effect of these variable parameters on surface hardness properties was examined. Besides, the effect of the variable parameters on the hardness properties was evaluated using 3\*3 array of the Taguchi method. As a result of the research, the highest hardness value was obtained in the combination of 50 mA/cm<sup>2</sup> current density, 9 g/l TMAB, and 5 g/l Cr<sub>3</sub>C<sub>2</sub>, while the lowest hardness value was obtained in the combination of 50 mA/cm<sup>2</sup> current density, 3 g/l TMAB, 1 g/l Cr<sub>3</sub>C<sub>2</sub>. When the samples were evaluated according to the 290.4 HV hardness value of base nickel, the sample with the highest hardness value had 2.43 times more hardness value, and the sample with the lowest hardness value had 2 times more hardness value than base nickel. Both TMAB content and Cr<sub>3</sub>C<sub>2</sub> content rising in bath concentration increased the hardness values of the specimens. It was figured out that the parameter that most affected the hardness values of the samples was the Cr<sub>3</sub>C<sub>2</sub> content with a contribution rate of 93.42%. The study revealed the potential of increasing the hardness values of coatings by adding Cr<sub>3</sub>C<sub>2</sub> nanoparticles to the electrodeposition process.

**Keywords:** Nickel, TMAB, Cr<sub>3</sub>C<sub>2</sub>, Electrodeposition, Microhardness, Taguchi



## PROPOSAL OF PIPE INSPECTION ROBOT USING PARALLEL ARRANGED EXTENSION TYPE FLEXIBLE PNEUMATIC ACTUATORS WITH AXIAL FIBER RESTRAINTS

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### Abstract:

In Japanese water supply system, a huge number of pipes are used. In particular, many pipes are passed the limited age of more than 50 years. It needs to investigate the pipe to find hazardous spots. In addition, due to long-term expansion work of piping, various sizes of pipes were used. Based on the critical situation, inspection robots are required for traveling in various pipes. It is better to use a flexible and slim inspection robot that can travel in complex pipes. In the previous study, to be easily facilitated recovery operations, the slim and straight-shaped pipe inspection robot with accordion motion of a snake was proposed and tested. To realize the combination of coiling motion and extension motion for accordion motion, an Extension type Flexible Pneumatic Actuator (we call it "EFPA" for short) with axial elastic and rigid fiber restraints was proposed and tested. By giving axial restraint, the EFPA could perform coiling after extension according to the increase of the inner pressure of EFPA. The inspection robot using single EFPA could also travel in a pipe by repeating accordion motion. However, the robot requires two pneumatic inputs to drive it from both side of EFPA. In this report, to improve the carrying force, the pipe inspection robot using parallel arranged EFPAs with axial fibber restraints is proposed and tested. The onboard and compact air supply system using on/off valve that can be operated supply air from the one side of EFPA is also proposed and tested. The traveling test using the improved robot was carried out. As a result, it could be confirmed that the improved robot could travel in the pipe while repeating accordion motion by only using air supply from the one-side of the robot.

**Keywords:** Extension type Flexible Pneumatic Actuator (EFPA), Parallel Arranged EFPAs with Axial Elastic/Rigid Fiber Restraint, Slim pipe



## PROPOSAL OF OUTER CIRCUMFERENTIAL HUGGING TYPE PIPE INSPECTION ROBOT WITH TRANSLATIONAL AND ROTATIONAL MOTIONS ALONG PIPE

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### Abstract:

Most pipe inspection robots have been developed for investigating the inside of the pipe. However, this type pipe inspection robots cannot use in working pipe that is full of liquid or gas. The cost for stopping the working pipe and removing fluid from the pipe to inspect is not ignorable in chemical plants. In addition, the cost for removing the covered insulation materials of chemical plant pipe becomes huge. Based on this situation, in this study, a pneumatic drive flexible pipe inspection robot that can hold the pipe without damage for covered insulation materials and move along the circumference of pipe in complex arrangements is proposed and tested. The robot consists of two Pipe Hugging type Soft Actuators (“PHSA” for short) and two Vertical Motion Soft Actuators (“VMSAs” for short) that are set so as to make a grid. PHSA consists of parallel arranged two Extension type Flexible Pneumatic Actuators (“EFPAs” for short) and restraint plates. The EFPA is made of the rubber tube covered with bellows tube. The VMSA consists of a serial connected Bending Soft Mechanism (“BSM” for short) and two pneumatic cylinders. As one side of PHSA is restrained by a PET plate, the PHSA can bend and hold the pipe. In this study, the climbing up and down along the vertical pipe using the proposed robot was carried out. As a result, it could be confirmed that the robot could climb up and down every 130 mm smoothly. By using BSM, the robot could rotate along the pipe without changing its height.

**Keywords:** Outer circumferential hugging type pipe inspection robot, Pipe hugging type soft actuator, Extension type flexible pneumatic act





## PROPOSAL OF LOW-COST AQUA DRIVE SYSTEM USING SLIDE GATE MECHANISM TYPE SERVO VALVE

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### Abstract:

Tap water is the most familiar fluid pressure source wherever exists in spaces where human lives. However, since devices used in water control system need to be made of rust-proof materials, they become expensive. If a low-cost aqua drive system can be realized, the spread of fluid drive systems at homes can be promoted. To realize the low-cost aqua drive system, the valve that is the most expensive device in fluid power system is very important. In this study, we aim to develop a low-cost servo valve that can operate tap water. In the previous study, the low-cost pneumatic servo valve using a slide gate mechanism and diaphragm was developed. In this report, the low-cost water hydraulic servo valve with a large opening area so as to operate tap water is reported. We also introduce the mechanism with double diaphragm to decrease larger shear force at the gate at the gate caused by increasing the stroke of the gate. The characteristics of the tested valve using tap water with typical pressure of 260 kPa was investigated. As a result, it could be confirmed that the prototype valve could control output flow rate proportionally and generate a maximum flow rate of 4.5 L/min. In addition, the aqua driving system using the tested low-cost valves and tap water was proposed and tested. As a result, it could be confirmed that the proposed system could operate double acting type water hydraulic cylinder using tap water.

**Keywords:** Slide gate mechanism type servo valve with dual diaphragms, Aqua drive system using Tap water, Low-cost control servo valve



## AIR TRAFFIC SECTORS OPTIMISATION

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### Abstract:

Air Traffic Sectors Optimisation (ATSO) is module tool linked and embedded in EUROCONTROL SAAM Tool (System for air traffic Assignment and Analysis at a Macroscopic level) for global optimisation of Air Traffic Management Systems (ATM). It is used to develop and improve airspace, capacity, delay and air traffic management, with objective to optimize use of airspace for civil and military users. With this module tool we can optimize imbalance between traffic demand and sector capacity and support designers and managers to make optimal decision for a strategic level of operations. The idea of this paper is to use ATSO module and its capability to check what would happen to the overall ATM performance/capacity if the spare capacity was utilised and, if no solution was found, which areas should be examined as a priority to create additional capacity. The benefit of air traffic sectorisation is presented in this paper showing how the entry rate for overloaded and congested sectors are changed.

**Keywords:** air traffic management, delay, optimization and sectors





## PROPOSAL OF PNEUMATIC SOFT ACTUATOR WITH PARALLEL LINKED EFPA AND VERTICAL COMPRESSIBILITY

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### Abstract:

In the critical situation due to ageing society and decreasing birth rates in Japan, the reduction of welfare expenses and the secure of elder skilled workers are important. In order to achieve these, it needs to maintain the health of the elderly for as long as possible. At the beginning, it is necessary to prevent frailty. As a device to prevent frailty, a healthcare support device that can be used while enjoying video games is useful to keep training and motivation. In the previous study, an 18-legged mobile robot / seat simulator that can give translational force, rotational forces, inclined angle and vibration for a user was developed. The robot using 18 tetrahedral shaped actuators (TSAs) as a robot leg. The TSA consists of three Extension type Flexible Pneumatic Actuators (EFPAs) restrained by 10 PET sheets. In this study, we aim to develop more suitable actuator as a seat simulator. A soft actuator that can give translational force, inclined angle and vibration for user without moving from the setting position is proposed and tested. The tested actuator consists of six EFPAs, coil springs and two acrylic plates. The tested actuator also has vertical compressibility. The driving test of the tested actuator was carried out. As a result, it could be confirmed that the upper acrylic plate of the tested actuator could move horizontally toward six radial directions every 60 degrees and tilt toward six radial directions every 60 degrees by changing pressurized EFPAs.

**Keywords:** Extension type Flexible Pneumatic Actuator, Seat Simulator, Parallel Link Using Pneumatic Soft Actuator



## PROPOSAL OF RIDING TYPE HOME-BASED MULTI-LEGGED MOBILE ROBOT/SEAT SIMULATOR

Yuma Adachi<sup>a\*</sup>, Tetsuya Akagi<sup>a</sup>, Shujiro Dohta<sup>a</sup>, Feifei Cho<sup>a</sup>, Takashi Shinohara<sup>a</sup>, Masashi Yokota<sup>a</sup>

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### Abstract:

Based on super aging society in Japan, a home-based rehabilitation device that can give passive exercise to maintain recovered joint moving area after physical therapist treatment has been desired. As the purpose of core training while playing video game, a multi-legged mobile robot / seat simulator that can translate and rotate as a movable cushion was developed. The robot consists of 18 Tetrahedral-shaped Flexible pneumatic Actuators (TFAs) using three Extension type Flexible Pneumatic Actuators (EFPAs) with 10 restraint PET sheets. The estimated lifting force of the robot / simulator is 2700N (150 N per leg). In this report, a driving test of the mobile robot with a person on board was carried out to estimate the usefulness of the mobile robot as a home-based healthcare support device. As a result, it can be confirmed that the mobile robot can move, rotate and tilt while its legs buckle slightly during the bending motion. In addition, the acceleration during translational and rotational motions of the mobile robot was investigated to estimate the effect of the buckling in the robot's motion.

**Keywords:** Multi-legged Mobile Robot, Seat Simulator, Extension Type Flexible Pneumatic Actuator; Tetrahedral-shaped Flexible Pneumatic Act



## NEW GENERATION NAVIGATIONAL TECHNOLOGY; MASS AND HOW EFFECTS ON MARITIME TRANSPORTATION

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### Abstract:

The effect of the principle that the only constant is change in today's technology is enormous. Thanks to the developing and changing technology, all sectors in the service of humanity provide a higher level of service. Since more than %//0 of the surface is called a geoid, which does not have a regular form on which we live and is covered with water geography, the interaction related to sea and maritime is at a high level. Maritime transportation, which carries around 90% of the world's transportation of products, is a global industry of immense significance. Therefore, it must adapt to changing technology. It has been significantly affected by unmanned technology, and the possibility of uncrewed ships operating in the future is being considered. Developed and seafaring nations are trying to operate ships with Maritime Autonomous Surface Ships (MASS) technology. The study has researched the latest developments and how shipping will interact with unmanned technology.

**Keywords:** Maritime Transportation, Strategy of Maritime Management, MASS, Management in Shipping, Maritime Politics



## A ROBUST FIXED POINT ITERATION METHOD FOR SOLVING NONLINEAR INDUSTRIAL EQUATIONS

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### Abstract:

Nonlinear equations frequently arise in industrial applications, from fluid dynamics and chemical reactions to mechanical systems and material sciences. The fixed point iteration (FPI) method is a powerful and widely used numerical technique for solving such nonlinear equations. In this study, we explore the capability of the fixed point iteration method to handle a variety of nonlinear problems in Banach space. Convergence analysis is presented using Taylor's expansion about a fixed point. Numerical experiments were conducted on diverse nonlinear equations. The presented method is modified version of Sharma method which has the order of convergence equals two. Additionally, we study the basins of attraction of presented method along with the methods available in the literature. The numerical results and visual comparison ensures the robustness of the proposed method. This work contributes to the ongoing efforts in industrial mathematics to optimize numerical methods for solving complex nonlinear problems. The method provides new insights in this direction.

**Keywords:** Fixed point method, Basins of attraction, convergence order, Banach space

## **FULL-TEXT ARTICLES**



# Encrypted Messaging Application Combining Advanced Encryption Standard and Rivest, Shamir, Adleman Algorithms

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## Abstract

*Instant messaging applications, driven by smartphone usage, have expedited communication and simplified sharing of messages, photos, and videos. However, this rise in mobile communication has heightened concerns about personal data security, particularly user privacy and data protection. End-to-end encryption is a key solution, ensuring messages are only accessible to the sender and recipient, preventing intermediary access. Some platforms, however, may use user data for advertising, raising ethical concerns. Therefore, prioritizing end-to-end encryption is essential for secure digital communication. This article reviews the security protocols of current messaging platforms, discusses encryption methods, and emphasizes the importance of privacy protection in advancing secure communication.*

**Keywords:** End-to-End Encryption, Personal Data Security, Cryptography, RSA, Socket, Secure, Secure Data Storage, Secure Instant Messaging.

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## 1. INTRODUCTION

Today, many people prefer mobile messaging applications to communicate with other users. While these applications stand out with features such as functionality, user-friendly interfaces, and visual appeal, security and privacy are also critically important. Most users want their data to be protected and inaccessible to third parties. However, many popular applications do not meet these standards and have the potential to sell user data to advertisers [1].

Some messaging applications offered for free can use the data they obtain by tracking user activities to sell to third-party advertisers [2]. Additionally, it has been observed that many chat applications, which are claimed to be secure and privacy-focused, do not use End-to-End Encryption (E2EE) technology [3]. This project aims to meet the security and privacy needs of our users, in addition to important criteria such as design and usability. To this end, by focusing on E2EE technology, it is aimed to contribute to the needs of the current market. As a result, the transmitted data is protected during transfer, and third parties, even application developers, cannot access this data. Encrypted messages can only be decrypted on the recipient's side. However, while ensuring the confidentiality and security of data using end-to-end encryption technology, the ability to monitor government surveillance and track terrorist communications is also restricted [4].

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This study aims to address the security deficiencies in the current market and to provide a secure communication platform by prioritizing user privacy.

## 2. LITERATURE REVIEW

Information is an important element that must be protected among societies. Throughout history, various techniques have been developed to safeguard information. Although there are a series of methods for information security, storing and concealing information are among the most fundamental steps. The cornerstone of this field is known as cryptology. With technological advancements, data sharing and transfer have become widespread in various areas such as communication networks, banking transactions, mobile phones, computers, the internet, and even transportation. The confidentiality, security, and integrity of this data are ensured through various encryption methods [5].

Cryptography is divided into asymmetric key encryption and symmetric key encryption.

### 2.1. Symmetric Key Encryption

Symmetric algorithms are named "symmetric" because they use the same key for encrypting transmitted data and decrypting the cipher. Both parties in communication must possess the same encryption key. This necessitates the use of a shared key to ensure secure communication.

For example, in a communication between two parties, Alice and Bob, they first agree on a shared key and keep this key secret. Then, Alice encrypts the message to be sent using this shared key and sends the encrypted message to Bob. Bob can decrypt the encrypted message using the same key.

### 2.2. Asymmetric Key Encryption

Asymmetric encryption is a fundamental method for secure communication, employing two different types of keys: public keys and private keys. This system uses different keys for encrypting and decrypting messages. The public key is generally published and used for encrypting messages. However, only the recipient's possession of the private key is necessary to decrypt the encrypted messages.

Asymmetric encryption not only ensures the security of messages but also can be used for authentication and identity verification. This method is more secure than symmetric encryption methods because breaking the keys is more difficult. However, using the keys involves computational processes, which can heavily utilize CPU time. Some of the most common asymmetric encryption algorithms include Diffie-Hellman Key Exchange and the RSA algorithm [6].

The table below provides a comparison of commonly used messaging applications today in terms of encryption.

Apps	Criteria	
	End-to-end Encryption	Encryption Algorithms
Whatsapp	+	Signal protocol
Telegram	Only private chats	MTPROTO Protocol
Signal	+	Signal Protocol
iMessage	+	Unknown

Table I. Comparison of Messaging Applications

## 3. USED TECHNOLOGIES

In this study, the aim was to develop an end-to-end encrypted messaging application. The application was designed using the Flutter platform, and encrypted messages were stored in Firebase Firestore database. An external Node.js server was used for





message transmission, and this server was deployed using the ngrok plugin. The technologies used in the study are presented below.

### **3.1. Flutter**

Flutter is an open-source UI development toolkit developed by Google. The application's user interface and functionalities are built with Flutter. Flutter uses a high-performance rendering engine to create visual components, enabling Flutter-developed applications to offer performance comparable to native applications. Architecturally, the engine's C or C++ code is compiled first by the Android NDK and then by LLVM for iOS. At one stage of this compilation process, Dart code is compiled into native code [7].

### **3.2. Firebase Firestore**

It is a cloud-based NoSQL database service provided by Google. It has been used to store messages in encrypted form. Storing data in JavaScript Object Notation (JSON) format, it is a NoSQL-based server that does not use queries for operations such as addition, update, or deletion on this data [8].

### **3.3. Node.js**

It is a JavaScript-based server environment used to facilitate server-side communication for messaging sockets.

### **3.4. ngrok**

It is a tool that securely exposes local servers to the internet during the development phase.

### **3.5. RSA Algorithm**

It is an asymmetric encryption algorithm used in individual messaging.

### **3.6. AES Algorithm**

It is a symmetric encryption algorithm used in group messaging.

## **4. EXPERIMENTAL STUDY**

The process from when the user installs the application until sending a message, and the background processes that occur after sending the message, are outlined below.

### **4.1. Registration Process**

Users register on the application using their phone numbers. They can start using the application by first entering the code sent to their phone numbers.

During this step, when a user registers, public and private keys are generated simultaneously for the RSA algorithm. The public key is saved in the database, while the private key is stored only on the user's phone and is not stored on the internet in any way.

### **4.2. Sending Individual Message**

After logging into the application, the user sees other users on the homepage. When the user clicks on a user they want to message, they are taken to the messaging screen. On the messaging screen, a socket connection is established while the page is loading. At the same time, previous messages are retrieved from the database.

When a user sends a message, it is encrypted using both the sender's public key and the recipient's public key. This allows the sender to also view the message they sent.





Image 1. Screen showing encrypted states of messages in the database and socket connection

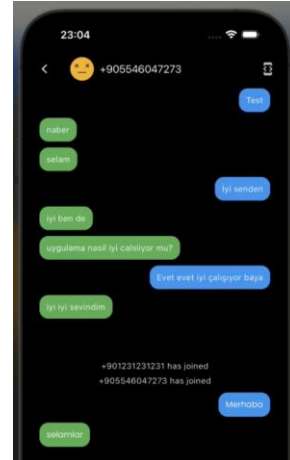


Image 2. Individual messaging screen

The encrypted message is first sent to the recipient through the Node.js server via socket. The recipient decrypts the received encrypted message using their private key stored on their phone. This ensures encrypted messaging between the two parties over the socket.

On the other hand, when the message screen is exited, the socket connection is terminated. Therefore, encrypted messages are sent to the recipient via the socket and simultaneously added to the database in encrypted form. This ensures that when the socket connection is re-established, previous messages are retrieved from the database, preventing data loss.

### 4.3. Sending Group Message

Users can send messages to both individual contacts and groups they have joined. Groups are visible in the "Groups" tab. Clicking on any group triggers a query. Messages within groups are encrypted using the AES encryption algorithm. Therefore, users who wish to send messages to a group must possess the AES key for that group. Unlike the RSA algorithm, which uses asymmetric key pairs, AES relies on a single symmetric key. This situation gives rise to two different scenarios.

#### 4.3.1. If User Does Not Have the Group's AES Key

In this case, to obtain the AES key, the user sends a request to the person who created the group. The creator of the group can view these requests in the "requests" tab.

#### 4.3.2. Page Numbers, Headers and Footers

In the scenario where a user creates a group and another user requests to join, AES and RSA algorithms are used together. The user who creates the group sees the request from the user who wants to join and presses the allow button. Here, the user who created the group encrypts the AES key with the public key of the user's registration stored in the internet. Then, the user decrypts this request message with the can even if by into called.

The loading of group messages and activities such as sending messages are similar to individual messaging. However, in this case, encryption is done using the AES algorithm instead of the RSA algorithm. Other activities, such as sending messages via socket and storing/retrieving data from the database, remain the same.

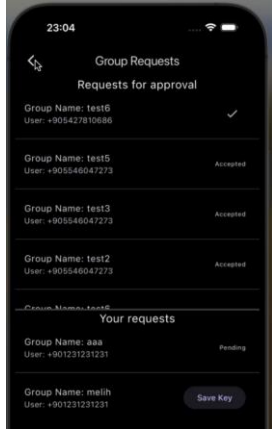


Image 3. Requests for AES keys by users to join a group



Image 4. Group messaging screen

## 5. RESEARCH FINDINGS

This research includes the results of a detailed literature review on information security and encryption topics. The study focuses on information security measures, encryption algorithms, and security policies of popular messaging applications.

The literature review highlights how information security techniques have evolved over time, emphasizing the fundamental role of cryptography in protecting information. Today, various cryptographic methods are adopted to ensure the security of data used across a wide range of applications from communication networks to banking transactions.

Among symmetric encryption algorithms, Advanced Encryption Standard (AES) and Rivest Cipher 4 (RC4) are prominent for their strong encryption capabilities, prioritizing the security of user data. Asymmetric encryption methods such as RSA and Diffie-Hellman are highlighted for secure key exchange and authentication.

The investigation into popular messaging applications examines the security policies of platforms like WhatsApp, Telegram, Signal, and iMessage, focusing on end-to-end encryption, privacy policies, and data processing methods. These applications demonstrate varying approaches to protecting user data.

In conclusion, this research provides an in-depth understanding of information security and encryption, serving as a valuable reference for future security applications.

## 6. DISCUSSION

In this project, a fully encrypted mobile messaging application is designed, developed, and implemented in detail. The application is coded using Flutter in the Visual Studio environment, aiming for accessibility across different operating systems and efficient performance.

The encryption of messages using the RSA algorithm ensures communication privacy. With Firebase integration, the application possesses a robust infrastructure, offering reliable support for user authentication, data storage, and real-time messaging.

These design and implementation decisions are expected not only to provide users with a secure and privacy-focused experience but also to serve as a motivating example for similar projects.



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# New Generation Navigational Technology; MASS and How Effects on Maritime Transportation

*Hasan Bora USLUER<sup>1</sup>*

## **Abstract**

The effect of the principle that the only constant is change in today's technology is enormous. Thanks to the developing and changing technology, all sectors in the service of humanity provide a higher level of service. Since more than 70% of the surface is called a geoid, which does not have a regular form on which we live and is covered with water geography, the interaction related to sea and maritime is at a high level. Maritime transportation, which carries around 90% of the world's transportation of products, is a global industry of immense significance. Therefore, it must adapt to changing technology. It has been significantly affected by unmanned technology, and the possibility of uncrewed ships operating in the future is being considered. Developed and seafaring nations are trying to operate ships with Maritime Autonomous Surface Ships (MASS) technology. The study has researched the latest developments and how shipping will interact with unmanned technology.

**Keywords:** Maritime Transportation, Strategy of Maritime Management, MASS, Management in Shipping, Maritime Politics.

## **1. INTRODUCTION**

The effect of the principle that the only constant is change in today's technology is enormous. Thanks to the developing and changing technology, all sectors in the service of humanity provide a higher level of service. Since more than 70% of the surface is called a geoid, which does not have a regular form on which we live and is covered with water geography, the interaction related to sea and maritime is at a high level [1].

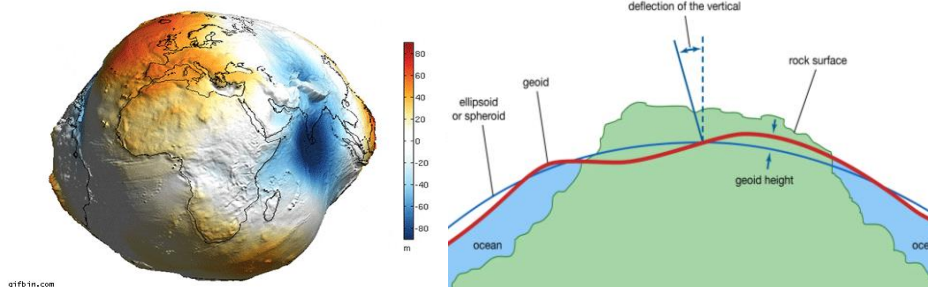


Figure 1. Geoid Formation. [2]

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Maritime transportation, which carries around 90% of the world's transportation of products, is a global industry of immense significance. Therefore, it must adapt to changing technology. It has been significantly affected by unmanned technology, and the possibility of uncrewed ships operating in the future is being considered.

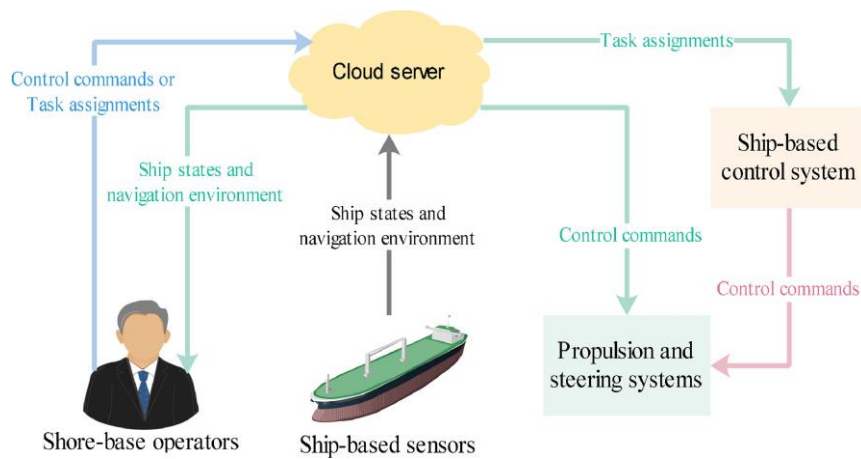


Figure 2. MASS technology remote sensing scheme by Sezer et al.

Developed and seafaring nations are trying to operate ships with Maritime Autonomous Surface Ships (MASS) technology. The study has researched the latest developments and how shipping will interact with unmanned technology.

## 2. MASS TECHNOLOGY GENERAL INFORMATION

**Maritime Autonomous Surface Ships (MASS);** The concept of autonomous ships, which can achieve full autonomy or become remotely controlled unmanned vessels, has significantly evolved. The IMO's Maritime Safety Committee initiated discussions on this topic as early as 1964. EU-funded research has greatly supported recent technological breakthroughs in information technology, digitalization, and machine learning, thereby opening the possibility of a practical application of some of these solutions to MASS.

Maritime autonomous surface ships (MASS) are an inevitable part of the maritime sector's future. Their development and evolution underscore the maritime sector's growing importance and autonomous technology's role in maritime operations. While they present challenges regarding safety, security, and the environment, MASS is a hot topic for testing and a key area of advancement for maritime nations, highlighting the need for adaptation and innovation in the industry [3,4].

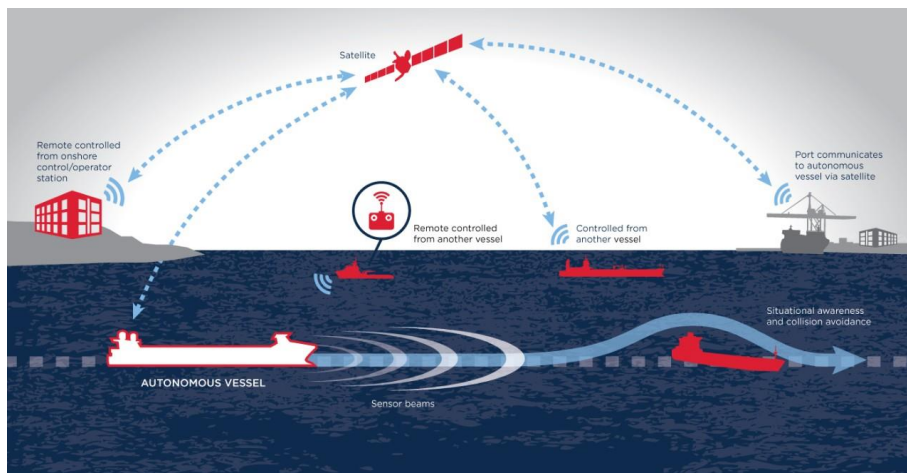


Figure 3. MASS Technology working cycle.

Developed technologies have substantially impacted diverse industries, especially maritime industries, significantly altering their traditional characteristics and operations. The implementation of automation has drastically changed the operational context of ships and marine systems. Maritime Autonomous Surface Ships that can be operated by less crew or unmanned create unique operational challenges [5,6].

According to the IMO (2021) [7],

There are Four degrees of Autonomy defined as follows:



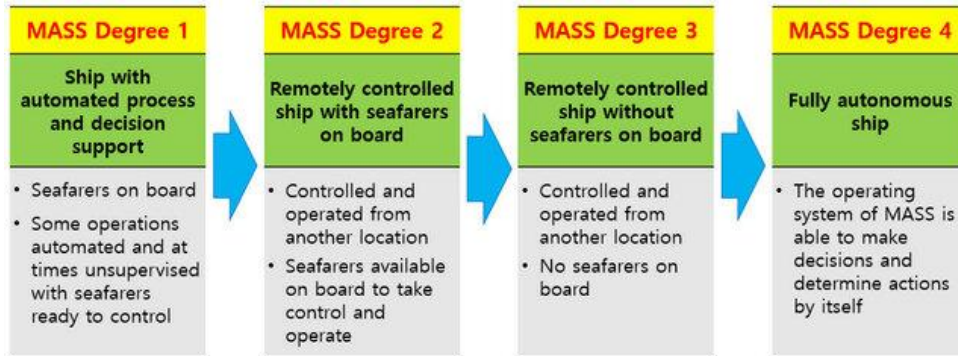
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Degree (1): Crewed ship with automated processes and decision support;

Degree (2): Remotely controlled ship with seafarers on board;

Degree (3): Remotely controlled ship without seafarers on board but controlled at the shore;

Degree (4): Fully autonomous ship.



Yara Birkeland is the world's first fully electric and autonomous container vessel with zero emissions. With this container vessel, Yara will reduce diesel-powered truck haulage by 40,000 journeys a year. Yara Birkeland was put into commercial operation in Porsgrunn in the spring of 2022. During the first to years of operation, the vessel will go through a gradual transition towards full autonomous sailing.

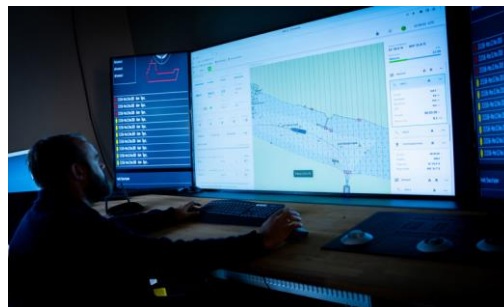


Figure 4. Yara Birkeland's working mentality [8].

### 3. MASS TECHNOLOGY EFFECTS ON MARITIME TRANSPORTATION

MASS is one of the most important results of developing and changing technology for maritime transportation. The unmanned ship, which completed its first voyage in Norway in 2022, has high-level benefits as it is equipped with

high-tech equipment. The most crucial argument in maritime transportation, the IMO, is most important as a rule maker is navigation safety. Many international agreements are used for this. However, it is known that the most crucial element is humans and that many of the accidents and defects experienced on the ship are caused by humans.



Figure 5. Remote control of the MASS

At this stage, ships and ports produced and operated with MASS technology provide many benefits but also include some problems.

In general, it has been observed that;

- 1-Human-related ship accidents have decreased relatively,
- 2-Fuel consumption has decreased, and route planning has been beneficial,
- 3-A general decrease in costs has been observed for ship-owner companies,
- 4-Reducing Emissions and Environmental Impacts,
- 5-Increased Safety by SOLAS and Reliability by all conventions,
- 6-Implementation and Adoption Challenges,

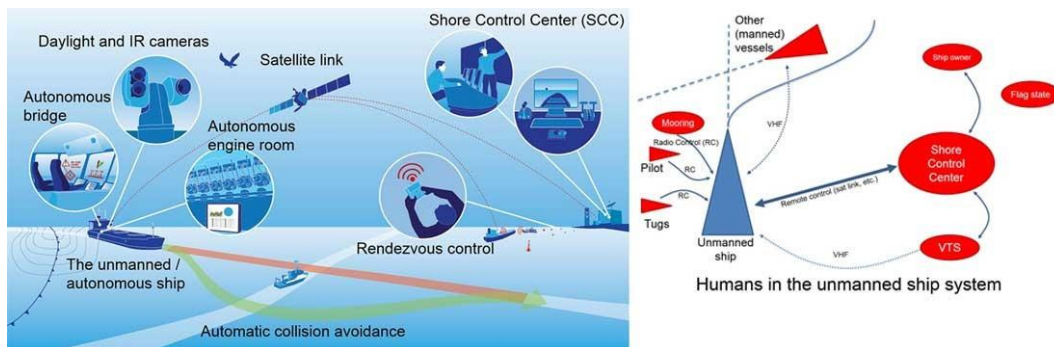


Figure 6. Remote control and use via satellite systems.

While many benefits can be listed, there are also disadvantages. Developed countries and their ports have high-tech maritime transport components, but there is a potential for growth and development in underdeveloped but raw material-based ports, which could be a significant factor in the widespread use of developing MASS technology.

In addition, there are studies on the maintenance, attitude, and continuity of the energy source of ships. However, the most crucial weakness is any attack that will threaten cyber security. Although developing technology provides benefits, it is also an opportunity for some people to sabotage. For this reason, large companies generally make severe investments in cyber security, ensuring a secure and protected maritime transport technology.

#### 4. RESULTS

Even though they have taken the human workload on ships with many safety measures taken by SOLAS, MASS technology ships have encountered other problems. As of today, it is necessary to separate the advantages with the principle of what is useful and what is not. Since it is a fully automated ship, it can realize all threats, from protection from cyber threats to damage to the cargo. However, all major maritime transportation invest in cyber security as an infrastructure.

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