



# **SENSOR BASED INTELLIGENT SYSTEMS**

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## **Preface**

In practical applications, sensors are often utilised as monitoring and observing components. Sensors, however, are unable to solve system problems since the data they collect must be processed for object functions. In industrial applications, there are several processing and decision-making strategies. For intelligent systems that utilise condition monitoring, detection, diagnosis, prognosis, and predictive maintenance in particular, it is crucial.

There are mainly four parts to the predictive maintenance. For the purpose of identifying abnormalities and problematic conditions, these components include condition monitoring, detection, diagnosis, and prognosis. The condition monitoring process involves keeping an eye on one or more metrics to spot any unexpected circumstances. Observable effects in a monitored system are used in the detection to show if there is an abnormal condition. The procedure of finding and locating the abnormality is called diagnostic. The prognosis is an assessment of a system's usefulness and health.

For the identification, diagnosis, and prognosis of problems, several predictive maintenance strategies have been enhanced in the literature. The approaches for detection, diagnosis, and prognosis rely on measurements and data that has been preprocessed utilising condition monitoring. Then, a system health result is provided by the predictive maintenance techniques. The performance of the predictive maintenance approach is impacted by the many uncertainties that exist in systems. To overcome this drawback, intelligent systems are used. The following describes the predictive maintenance process flow. First, measurements are made of the system's real operations or signals for condition monitoring. Second, the anomaly detection determines if the system is functioning normally or improperly for early recognition. Thirdly, anomaly categorization for accurate diagnostic assignment is possible. Next, abnormalities may be estimated or predicted using the prognosis stage. Ultimately, decision-making produces an outcome.

Specifications for an effective predictive maintenance technique should be included. The bare minimum of data and sensors should be needed first. Other requirements include rapid reaction, resilience, and accurate and confident prediction. Predictive maintenance techniques can use optimization algorithms like genetic algorithms, artificial immune systems, and sophisticated Monte Carlo methods, learning algorithms like artificial neural networks and support vector machines, and reasoning algorithms like fuzzy logic, clustering, particle filtering, wavelet analysis, and principal component analysis. These techniques may also be used to feature extraction, feature selection, and data preparation.

The use of computational intelligence approaches in predictive maintenance procedures is crucial for enhancing manufacturing, production, and product quality. Most issues may be fixed now if the problematic state in a system can be identified with the detection, the diagnosis, or the prognosis at an early stage.

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## CHAPTER 1

# INTRODUCTION TO A SYSTEM TO PREDICT HEART ATTACKS USING A MACHINE LEARNING ALGORITHM

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Heart disease is one of the biggest problems facing people around the globe today. The prevalence of cardiovascular illnesses is among the greatest in the contemporary era. A study found that around 17.7 million deaths worldwide each year are attributable to heart disease. An estimated 7.4 million of these fatalities were attributed to coronary heart disease and 6.7 million to strokes. Heart attacks are one of the worst illnesses that may kill a person at any moment without warning, and most physicians are unable to foresee silent heart attacks. Building an effective cardiovascular disease prediction system has become necessary due to a shortage of doctors and an increase in incidences of incorrect diagnoses. This prompted the study and creation of novel machine learning and medical data mining approaches. The major goal of this research is to use a machine learning algorithm to extract important patterns and features from the medical data and then to choose the qualities that are most useful for heart attack prediction. The project's goal is to build a prototype that uses real-time inputs to forecast the likelihood that a certain user will have a heart attack in the future. This aids in accurate patient diagnosis and has the potential to prevent the loss of countless lives.

IoT is a technology used in the hardware model. The Internet of Things (IoT), which links gadgets, sensors, appliances, cars, and other "things," is the next phase of the linked world. We can link anything, get access from anywhere, at any time, and quickly access any service or data about any item thanks to the Internet of Things. IoT aims to increase the advantages of the Internet by enabling remote control, data exchange, continual connection, and other features. All of the gadgets would be connected to local and international networks via an integrated sensor that is constantly gathering data.

The Internet of Things (IoT) technology may provide a lot of information about people, things, time, and places. We utilise the cloud to store this data. The distribution of computer services, such as servers, storage, computers, networking, software, analytics, and intelligence via the internet is referred to as cloud computing. Faster innovation and flexible resources are offered by "The Cloud." IoT, which is built on inexpensive sensors and wireless communication, offers a lot of space and cutting-edge services when combined with existing internet technologies. The rise of Internet and Internet of Things integration is aided by IPv6 and cloud computing. More opportunities for data collection, processing, port management, and other new services are being made available. The hardware model is constructed using these technologies.

The transmitter module (Arduino), which contains a heartbeat sensor to measure the heartbeat rate, makes up the hardware model. An LCD screen and a Wi-Fi module make up the receiving module.

The sensor connected to Arduino is used to monitor the patient's heart rate data. Using an Internet-connected Wi-Fi module as a communication channel, the gathered data may be safely evaluated and forwarded to the server. Every 10 seconds, all sensor data is sent to a remote IoT server. ThingSpeak, a secure open-source cloud service, is used to store the communicated data. The cloud-based real-time data that is gathered is utilised to build software. To provide precise results with a minimal amount of mistakes, the software model includes machine learning and data mining. Machine learning is an artificial intelligence (AI) feature that mimics how the human brain processes data and builds patterns to be used in object detection, voice recognition, and decision-making. It is a more effective method and has networks that can learn unsupervised from unstructured or unlabeled input.

Without entirely relying on manually created features, a system may learn complicated functions directly from data by automatically learning features at various levels of abstraction. Artificial neural networks are a branch of machine learning in artificial intelligence that deals with algorithms motivated by the composition and operation of the brain. A component of a computer system called an Artificial Neural Network (ANN) is designed to mimic how the human brain evaluates and processes information. It serves as the cornerstone of artificial intelligence and resolves issues that, by human or statistical criteria, would be considered impossible or challenging. Because ANNs are self-learning, they may provide better outcomes as more data becomes available. An ANN consists of hundreds or thousands of processing units, which are artificial neurons linked by nodes.

Input and output units make up these processing units. The neural network makes an effort to learn about the information supplied to generate one output report from the input units, which receive diverse forms and structures of information based on an internal weighting system. The input provided is a data set, which is a group of data points that a computer can analyse and forecast as a single entity. The parameter set in the data set is used to forecast heart attacks. We use the Data Mining method to reduce the complexity of the enormous data collection. It involves using techniques from the confluence of machine learning, statistics, and database systems to extract and find patterns in massive data sets.

Following this procedure, it was discovered that age, heart rate (HR), blood pressure, hyperglycemia, and cholesterol are the key indicators for predicting a heart attack. The software model is trained to take the data in these parameters into account. Support vector machines, logistic regression, artificial neural networks, K-nearest neighbours, Naive bays, and decision trees are some of the categorization techniques used in the software system's development. The most effective algorithm is utilised to train the model, depending on how accurate the algorithms are. Finally, utilising real-time heart rate data from the cloud and a classification model created using classification algorithms trained on a heart illness dataset, heart attack predictions are constructed.

With the aid of this research, patients will be able to monitor their daily heartbeat and get an early warning in the event of a heart attack. All medical professionals have access to the information, can examine it, and may make decisions based on it to provide efficient services remotely for the advancement of society. It's crucial to frequently assess your health to ensure that your body is always in top shape and maintains good health.

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## CHAPTER 2

### APPLICATION OF MACHINE LEARNING

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Machine learning, an application of artificial intelligence (AI), gives systems the capacity to autonomously learn from experience and become better over time without being explicitly programmed. The science of teaching computers to learn and behave like humans are known as machine learning. Machine learning is similar to gardening or farming. Plants are the algorithms, seeds are the data, you are the gardener, and nutrients are the data [1]–[3].

The use of machine learning

- Web searches rank pages according to which links you are most likely to click.
- Computational biology: logical computer drug design based on prior experiments.
- Finance: Select the recipients of your credit card offers
- Risk assessment of credit offers. How to choose where to invest.
- Robotics: how to deal with uncertainty in unfamiliar settings. Autonomous. Autonomous vehicle
- Online shopping: predicting consumer attrition. Whether a transaction is fraudulent or not.
- Radio astronomy and space exploration (space probes).
- Information extraction: Query databases on the internet.
- Data about connections and interests may be found in social networks. Using machine learning to get the most out of data.
- Debugging: Apply to issues like debugging in computer science. Work-intensive procedure. May provide a possible location for the problem.
- Machine learning algorithms also aid in increasing customization and customer experience on online platforms.
- Recommendation systems are used by Facebook, Netflix, Google, and Amazon to avoid content saturation and provide unique material to specific individuals based on their preferences.
- Facebook uses recommendation systems to locate appropriate leads for its advertising services as well as for its news feed on Facebook and Instagram.

Netflix gathers user information and makes movie and television show recommendations based on the user's tastes. Among many other uses, Google uses machine learning to organise its search results and for YouTube's recommendation engine. By proposing items that the customer is truly interested in purchasing, Amazon utilises ML to display relevant goods in the user's field of vision and increase conversion rates.

#### Machine Learning's Essential Components

Representation: how knowledge is represented.

Examples include model ensembles, neural networks, decision trees, sets of rules, instances, graphical models, and more. Evaluation: How to assess potential programmes (hypotheses).

Examples include precision, recall and prediction, squared error, probability, cost, margin, k-L divergence, likelihood, and others [4]–[6].

## Machine Learning Types

Four categories of machine learning exist:

- Supervised learning, also known as inductive learning, uses training data that contains intended results. This is spam; learning is under supervision.
- Unsupervised learning: The training set excludes the intended results. Clustering is an example. It might be difficult to distinguish between excellent and bad learning.
- Training data comprises a few desirable outputs in semi-supervised learning.
- Rewarding a series of actions: Reinforcement learning. It is the most challenging kind of education.

## Section Four: System Design

The prerequisites for the software

- **AVRIN O IDE**

Java is used to create the Arduino integrated development environment (IDE), which is available for Windows, macOS, and Linux (figure 4.4.1). It is used to create and upload applications to boards that are compatible with Arduino as well as other vendor development boards with the aid of third-party cores. The Arduino IDE has specific code organisation guidelines to support the languages C and C++. Because it is an official Arduino programme, code compilation is so simple that even the average individual with no previous technical expertise may get started learning. The primary code, often referred to as a sketch, written on the IDE platform will eventually produce a Hex File, which is transported to and uploaded into the controller on the board. The primary code, often referred to as a sketch, written on the IDE platform will eventually produce a Hex File, which is transported to and uploaded into the controller on the board. There are three basic divisions of the IDE environment: Output Pane, Text Editor, and Menu Bar.

- **C EMBEDDED**

The C programming language has an extension called Embedded C that helps programmers create effective applications for embedded hardware. It is not a component of C. The most popular programming language for embedded controllers and processors is C. Assembly is also utilised, however it is mostly employed to implement those parts of the code that need very high timing precision, code size efficiency, etc.

Since the Arduino IDE (Integrated development Environment) can compile both Arduino and AVR standard code, it is fully functional and packed with libraries, making it possible to programme the Arduino UNO in Embedded C.

- **PYTHON**



Python is a high-level, all-purpose programming language that is interpreted. Python's design philosophy places a strong emphasis on code readability via the use of noticeable indentation. Its language elements and object-oriented methodology are intended to aid programmers in creating clean, comprehensible code for both little and big projects. Python is garbage-collected and has dynamic typing. It supports a variety of paradigms for programming, including functional, object-oriented, and structured programming. Due to its extensive standard library, Python is sometimes referred to as a "batteries included" language.

- **CLOUD OF THINGS SPEAK**

Assembling, visualising, and analysing real-time data streams in the cloud is possible with the help of the IoT analytics platform service ThingSpeak. Data sent by your devices to ThingSpeak is instantly visualised by ThingSpeak. For IoT systems that need analytics, ThingSpeak is often used for prototype and proof of concept solutions. Each user has their own level of security thanks to the SSID and password. Moreover, the user will own an API key.

Features of Thing Speak:

1. Gather information through private channels
2. Disseminate data using open channels
3. Analytics and visualisation with MATLAB
4. Event planning
5. Alerts
6. Integrations of apps MATLAB, Arduino, Particle Photon and Electron, ESP8266 WIFI Module, Raspberry Pi and Things Network are all compatible with ThingsSpeak.

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## CHAPTER 3

### ESP32 SPECIFICATIONS

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It is challenging to incorporate all the specs in this Getting Started with ESP32 tutorial since ESP32 has many more functions than ESP8266. So, I've compiled a summary of some of the key ESP32 specs below. But I highly advise you to consult the Datasheet for the full set of specifications.

- A 32-bit LX6 microprocessor with a single or dual core with a clock speed of up to 240 MHz.
- 448 KB of ROM, 16 KB of RTC SRAM, and 520 KB of SRAM.
- Supports up to 150 Mbps 802.11 b/g/n Wi-Fi networking.
- Assistance with BLE and Classic Bluetooth v4.2 standards.
- 34 programmable GPIOs.
- Two channels of 8-bit DAC and up to 18 channels of 12-bit SAR ADC.
- There are 4 SPI, 2 I2C, 2 I2S, and 3 UART serial ports.
- Physical LAN communication with Ethernet MAC (requires external PHY).
- One SD/SDIO/MMC host controller and one SDIO/SPI slave controller.
- PWM for motors and up to 16 LED channels.
- Flash Encryption and Secure Boot.
- Hardware acceleration for AES, Hash (SHA-2), RSA, ECC, and RNG cryptographic operations.

#### Different Programming Methods

If a piece of high-quality hardware like the ESP32 can be programmed (written code) in several ways, it will be more user-friendly. The ESP32 offers a variety of programming environments, which is not unexpected. Programming environments that are often used include the PlatformIO IDE (VS Code), LUA, MicroPython, Espressif IDF (IoT Development Framework), JavaScript, and Arduino IDE.

We will utilise the Arduino IDE, which is currently a comfortable setting, to programme the ESP32 in our next projects. However, you may undoubtedly check out some others as well. The ESP32 Development Board's ESP32 DevKit

The ESPWROOM-32 Module is one of the numerous ESP32-based modules that Espressif Systems has produced. It is made up of an ESP32 SoC, a 4 MB Flash IC, a 40 MHz crystal oscillator, and a few passive parts. The PCB of the ESP-WROOM-32 Module contains edge castellations, which is advantageous. As a result, third-party manufacturers create a break-out board for the ESP-WROOM-32 Module. The ESP32 DevKit Board is one such board. It includes

the ESP-WROOM-32 as the primary module along with some extra hardware for quick ESP32 programming and GPIO Pin connectivity.

## Layout

By examining the design of the ESP32 DevKit Board, one of the well-known low-cost ESP Boards on the market, we can discover what makes up a standard ESP32 Development Board.

The following graphic displays an ESP32 Development Board's layout.

Important Information: The ESP-WROOM-32 Module is the foundation for many of the ESP32 Boards that are sold today. From board to board, the layout, pinout, and functionality differ.

I have a board with 30 pins (15 pins on each side). Some boards have 36 pins, while others have a few fewer. Check the pins again before connecting anything or even powering up the board.

- The ESP32 Board is made up of the following components, as you can see in the picture:
- Two rows of IO Pins
- ESP-WROOM-32 Module (with 15 pins on each side)
- Micro-USB Connector with CP2012 USB - UART Bridge IC (for power and programming)
- Boot Button
- Enable Button (for Reset)
- AMS1117 3.3V Regulator IC (for flashing)
- User LED (Blue) coupled to GPIO2
- Power LED (Red)
- Some passive components
- The USB-to-UART IC's DTR and RTS pins are used to automatically put the ESP32 in programming mode (when necessary) and rest the board after programming, which is an intriguing feature.

## Board's ESP32 pinout

- I'll create a unique lesson just for the ESP32 pinout. Look at the ESP32 Development Board's wiring diagram for the time being, however.
- DHT11 Sensor Pin Name and Description
- One Vcc power source 3.5V to 5.5V
- Temperature and humidity are output via serial data in two different ways.
- NC
- No connection, not in use.
- Ground Connected to the Circuit's Ground
- For the DHT11 Sensor module.
- One Vcc power source 3.5V to 5.5V
- Temperature and humidity are output via serial data in two different ways.

## Ground Affixed to the Circuit's Ground

The widely used DHT11 temperature and humidity sensor have an exclusive NTC for temperature measurement and an 8-bit microprocessor to output the temperature and humidity measurements as serial data.

### Specifications for DHT11

- Operating voltage ranges from 3.5 to 5.5 volts, and operating current ranges from 0.3 to 60 uA.
- Temperature Range: 0°C to 50°C • Humidity Range: 20% to 90% • Output: Serial Data
- Accuracy: 1°C and 1%; Resolution: Temperature and Humidity are both 16-bit measurements

### MAX 30102

The module includes the MAX30102, an updated (and MAX30100's successor) Analog Devices integrated pulse oximeter and heart rate sensor IC. It uses two LEDs, a photodetector, improved optics, low-noise analogue signal processing, and two LEDs to detect heart rate (HR) and pulse oximetry (SpO<sub>2</sub>) readings. The MAX30102 features a RED and an IR LED behind the glass on one side. An extremely sensitive photodetector is located on the other side. The concept is to illuminate one LED at a time, measure the quantity of light that is reflected at the detector, and then calculate the signature to determine the blood oxygen level and heart rate.

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## CHAPTER 4

### SENSOR FOR HEART BEAT

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The Italian company Arduino created the Arduino Nano, a compact, adaptable, and breadboard-friendly microcontroller board. Because Arduino Nano is a scaled-down version of Arduino Uno, its functionality is almost identical. Although each of these digital and analogue pins has been given a variety of tasks, their primary purpose is to be set up as an input or output. When they are connected to sensors, they function as input pins; however, if you are driving a load, you should utilise them as output pins.

Although the input voltage ranges from 7 to 12 volts, the operational voltage is 5 volts. There are 14 digital pins, 8 analogue pins, 2 reset pins, and 6 power pins on the Arduino Nano. The analogue pins measure values between 0 and 5V with a total resolution of 10 bits. When they are connected to sensors, they function as input pins; however, if you are driving a load, you should utilise them as output pins.

#### Laptop Display

A flat-panel display or another electronically manipulated optical device that makes advantage of liquid crystals' ability to modify light is known as a liquid-crystal display (LCD). Liquid crystals don't emit light directly; instead, they create pictures in either colour or monochrome utilising a backlight or reflector. A digital clock, for example, has a seven-segment LCD display that can show pre-programmed text, numbers, and other low-information visuals that may be displayed or concealed. They both make use of the same fundamental technology, however, different displays have bigger parts whereas random pictures are made up of a lot of tiny pixels.

Depending on the polarizer configuration, LCDs may be switched between being typically on (positive) and off (negative). A character-negative LCD will have a black backdrop with letters that are the same colour as the backlight, whereas a character-positive LCD will have black writing on a background that is the opposite of the colour of the illumination. Blue LCDs have optical filters applied to the white to give them their distinctive look. When compared to CRT and LED, LCDs use less electricity and have displays that use microwatts as opposed to milliwatts in LEDs. LCDs are inexpensive and have great contrast. When compared to LED and cathode ray tubes, LCDs are smaller and lighter.

#### Heart Rate Monitor

The purpose of the heart rate monitor is to measure the users' current heart rates. The circuit will be built around a non-invasive PPG sensor that monitors changes in blood flow in the finger in response to the mechanical contraction of the heart. A photodiode serves as an IR receiver while an infrared LED acts as an IR transmitter in the sensor. The photodetector measures the infrared

and red light intensity after it has passed through the finger. The following components make up the heart rate monitor's electronic system. Data collection, analogue signal conditioning and/or processing, digital signal processing, display and control systems, and data acquisition

## **WLAN MODULE**

The self-contained SOC with integrated TCP/IP protocol stack known as the ESP8266 Wi-Fi Module may provide your Arduino microcontroller access to your Wi-Fi network. The Express if system ESP8266 is a system-on-chip (SoC) module with Wi-Fi capabilities. It is mostly used for the creation of embedded IoT (Internet of Things) applications. It uses a 32-bit RISC processor with an 80 MHz clock speed based on the Tensilica Xtensa L106 (or over-clocked to 160 MHz). There are 96 KB of data RAM, 64 KB of instruction RAM, and 64 KB of boot ROM. Through SPI, external flash memory may be accessed. A low-cost standalone wireless transceiver that may be utilised for end-point Internet of Things advancements is the ESP8266 module. A series of AT instructions must be used by the microcontroller to connect with the ESP8266 module. ESP8266-01 module and microcontroller interact via a UART with a predetermined Baud rate pin explanation.

## **Software Development**

Python: Python is an object-oriented, dynamically semantic, interpreted high-level programming language. Its high-level built-in data structures, together with dynamic typing and dynamic binding, make it particularly appealing for use in scripting and rapid application development. Python's straightforward syntax prioritises readability and makes it simple to learn, which lowers the cost of programme maintenance. Python's support for modules and packages promotes the modularity and reuse of code in programmes. Both the vast standard library and the Python interpreter are the free source. Most people agree that Python is the best language for studying and teaching ML (Machine Learning).

- Features: Free and Open Source; Object-Oriented Language; High-Level Language; Extensible Feature; Easy to Code
- Python is a language that is integrated, interpretable, portable has a large standard library and is dynamically typed.
- Python IDLE: An IDE (or Integrated Development Environment) is a programme used to create software. IDEs combine several tools made expressly for creating software.
- These resources typically consist of a code editor (with, for example, syntax highlighting and autocompletion).
- Tools for building, running, and debugging, the Source control software of some kind.
- IDLE is pre-installed with Python.
- The Python shell window (interactive interpreter), auto-completion, syntax highlighting, smart indentation, and a simple integrated debugger are some of its key features. Python 3.6.8 was the version we used.

## **HTML:**

The code used to organise a web page's content and structure are called HTML (Hypertext Markup Language). Content may be organised using paragraphs, a list of bulleted points, graphics, and data tables, among other options. HTML is a markup language that specifies how your material is organised. HTML is made up of several components that you may employ to enclose or wrap certain portions of the content to alter how it appears or behaves. The surrounding tags may italicise words, make the font larger or smaller, make a word or picture connect to another location, and more.

### **Structure of an HTML Element:**

The following are the major components of our element:

The element's name, in this example `p`, is enclosed in opening and closing angle brackets in the first tag. This specifies the point at which the element starts to take effect, in this instance the start of the paragraph.

- The closing tag: This is similar to the opening tag, with the exception that the element name is preceded by a forward slash. This indicates the end of the element, in this instance the end of the paragraph.
- One of the typical novice mistakes is forgetting to include a closing tag, which might have unusual outcomes.
- The content: This is the element's content, which is the text in this example.
- The element: The element is made up of the content, the opening tag, and the closing tag.

### **Elements may also possess the following attributes:**

Additional details about the element are included in its attributes and are not intended to be seen in the content itself. In this case, the property name is `class`, and the attribute value is `editor-note`. You may target the element and any other elements with the same class value with style information and other things by assigning it a non-unique identifier using the class property.

The following should always be included in an attribute:

- Add a space before the element name or the previous attribute, if the element already has one or more attributes.
- The name of the attribute is followed by the equal sign.
- The attribute value is enclosed in quotation marks, both at the beginning and end.
- Certain components are empty and have no content. Consider the existing `image` element on our HTML page: `/img>` tag with no inside content. This is due to a picture.
- There are two properties here, but there is no closing element to influence the content since it is not wrapped. Its goal is to position an image where it appears on the HTML page.

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## CHAPTER 5

### SYSTEM IMPLEMENTATION

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The system architecture comprises a heartbeat sensor that, when touched by a finger, produces a digital output of the heartbeat. A light-emitting diode and a detector, such as a light-detecting resistor or a photodiode, make up the basic heartbeat sensor. Blood flow to various parts of the body varies as a result of cardiac pulses. Tissue either transmits or reflects light when it is irradiated by the light source, in this case, light from the led. The blood absorbs some of the light, and the light detector picks up the light that is either transmitted or reflected. The quantity of blood present in that tissue affects how much light is absorbed. The microcontroller receives the sensor's digital output data directly and uses them to calculate the beats per minute (BPM) rate. A typical resting heart rate for a person who is 18 years or older might range from 60 to 100 beats per minute.

This sensor is fastened to the body so that the vital sign readings may be tracked, shown on an LCD screen, and sent to an Arduino Nano controller as well. Software implementation: Deep Learning is a technology that resembles the human brain in that it has several layers and numerous layers of neurons, much like the human brain. An input layer, an output layer, and one or more hidden layers make up the network as it has been created. The network makes predictions while attempting to learn from the data that is given to it. The ANN is the most fundamental kind of neural network (Artificial Neural Network). The ANN simply consists of several neural layers to be utilised for prediction; it has no unique structure [1]–[3].

The project's goal is to construct a self-learning protocol in which a user's future risk of developing heart disease is determined by prior inputs of illness outcomes. The proposed model uses robust pre-processing techniques to ensure that there are no dataset-related mistakes in the classification or prediction. The different significant characteristics and qualities are taken into account while choosing the appropriate attributes.

Deep learning techniques were used in the creation of the model that is suggested for the heart attack prediction system. The dataset has 13 columns with various parameters such as sex, age, cholesterol level, etc., along with a target column that indicates whether or not the subject has heart disease. Except for the target column, which will serve as our dependent variable, all the columns will remain independent variables. We'll create an ANN that uses a person's other characteristics to predict whether or not they have heart disease.

The microcontroller is coupled to an ESP32-based Wi-Fi module. The ESP32 Wi-Fi module provides connectivity to the internet or Wi-Fi. It is the most advanced gadget on the Internet of Things (IoT) platform and can interface with any microcontroller. The TCP/IP protocol is incorporated with it [4]–[6]. The data will then be sent to ThingSpeak through communication between the Arduino and ESP32. With the help of ThingSpeak, an IoT analytics platform service,

you can gather, view, and analyse real-time data streams in the cloud. The ESP32 will connect to the router's network using the information supplied in the code and transmit the sensor's data online.

ThingSpeak, an open-source cloud service with adequate security, is used for Internet of Things processing. Each user has their level of security thanks to the SSID and password. Moreover, the user will own an API key.

- It is possible to connect the sensors to ThingSpeakIoT with the aid of the Arduino IDE. Using Arduino controllers, the sensors automatically transmit the measured value to the IoT.
- The data sent from the Arduino controller to ThingSpeak is used for live monitoring and data export. The API makes it extremely simple to visualize gathered data using several formats. The diverse formats include graphical, gauge, and location-based methods. Compared to other APIs, the reports are considerably easy to examine and have attractive visuals.

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## CHAPTER 6

### SENSOR DATA

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The notion of many strategies that have been researched for detecting cardiovascular illness is presented in this article via a review of the literature. Utilizing big data, deep learning, and data mining may show promise in producing the most accurate analysis of the prediction model. The primary goal of this study is to diagnose a cardiovascular disease or heart disease utilising a variety of techniques and procedures to get a prognosis. Our risk of heart attacks has grown recently. This technology can detect heart attacks even while a person is at home by monitoring heart rate using a heartbeat sensor. This technology aids in-hospital monitoring, with each patient being watched after by a single worker in the server room. If this technology advances, we will be able to use it to identify heart blockages [1]–[3].

All sensor data is sent to a distant IOT server every 10 seconds. The sent data is kept in a secure open-source cloud service called ThingSpeak. Software is created using the cloud-based real-time data that is obtained. Software model uses data mining and machine learning to provide accurate results with a low error rate. Machine learning is an aspect of artificial intelligence (AI) that models how the brain analyses data and creates patterns to be used for decision-making, object identification, and speech recognition. It is a more efficient strategy that uses networks that can pick up information from unstructured or unlabeled input without supervision.

By autonomously learning features at multiple levels of abstraction, a system may learn complex functions directly from data without fully depending on manually constructed features. A subset of machine learning in artificial intelligence called artificial neural networks deals with algorithms inspired by the structure and function of the brain. An Artificial Neural Network (ANN) is a component of a computer system that simulates how the human brain assesses and processes information. It is the cornerstone of artificial intelligence and finds solutions to problems that would be impossible or difficult by human or statistical standards. ANNs are self-learning systems, so when more data become available, they could provide better results. An ANN is made up of a large number of processing units, or artificial neurons, connected by nodes.

These processing units are made up of input and output units. To produce one output report from the input units, which receive information in a variety of forms and structures based on an internal weighting system, the neural network attempts to learn about the information given. A data set a collection of data points that a computer can analyse and predict as a single unit is an input that is given. Heart attacks are predicted using the data set's parameter set. To simplify the vast data collection's complexity, we use the data mining technique. It includes extracting information from enormous data sets and looking for patterns utilising methods from the intersection of machine learning, statistics, and database systems [4]–[6].

Following this approach, it was shown that the most important predictors of a heart attack are age, heart rate (HR), blood pressure, hyperglycemia, and cholesterol. The data in these parameters are used to train the software model. Some of the classification methods employed in the creation of the software system include decision trees, K-nearest neighbours, logistic regression, artificial neural networks, support vector machines, and logistic regression. Depending on how precise the algorithms are, the best algorithm is used to train the model. Finally, heart attack predictions are built utilising real-time heart rate data from the cloud and a classification model developed using classification algorithms trained on a dataset of heart illnesses.

After using a genetic algorithm to reduce the real data for collecting the ideal subset of attributes that is sufficient for heart disease prediction, future study of this research work may be produced to generate an influence on the accuracy of the SVM and KNN for further improvement. In the future, an intelligent system may be created that can guide the patient with heart disease in choosing the best course of therapy. Making models that can forecast whether a patient is going to acquire heart disease or not has previously required a lot of studies. Once a patient has been identified with a certain kind of cardiac disease, there are numerous therapy options available. By collecting information from these pertinent databases, data mining may be a very useful tool in determining the course of therapy to be taken.

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## CHAPTER 7

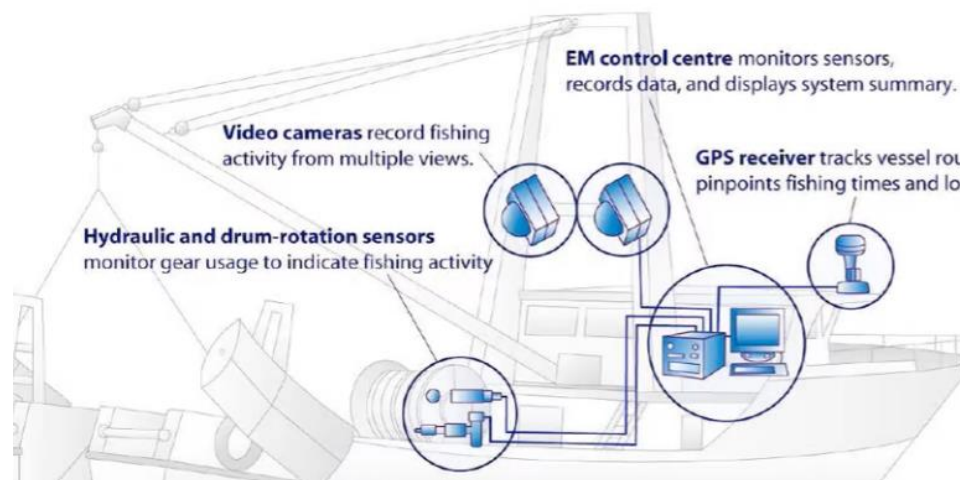
### INTRODUCTION TO ACCIDENT DETECTION

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India is the second-largest fish producer in the world, accounting for 5.68% of global fish output with an annual fish production of 9.58 million MT. About 39% of the output comes from marine fisheries. Despite making up just -4.6% of the agricultural GDP and 0.83% of the national GDP, this sector is an essential part of the rural coastal economy in 3202 settlements along an 8,118 km stretch of coastline. There are 0.9 million full-time jobs for fishers, while another 3.5 million people find work in the food processing and marketing industry. Since the Mesolithic era, people have used fishing to get sustenance [1]. The bulk of Egyptians' food was produced by fishermen during the period of the Ancient Egyptians. Since fishing has been used to collect food since the Mesolithic era, it has evolved into a key method of survival. As a commercial endeavor, that is. The goal of this initiative is to protect fishermen's lives when they are on the water. Wind speed, temperature, and humidity are all influenced by a variety of variables and events that operate on ranges ranging from micro to macro units. The pressure gradient, waves, jet streams, and other regional weather factors fall under this category [2], [3]. There are connections between wind direction and wind speed, particularly with the pressure gradient and the surfaces the air is located across. Figure 1 shows remote catch monitoring is possible on fishing boats thanks to an electrical system called EM Observe.



**Figure 1: An electronic technology called EM Observe allows for remote catch monitoring on fishing boats.**

In the vehicle industry, there are several anti-collision or collision avoidance technologies, including ABS, blind spot monitoring, Emergency Braking Assist (EBA), etc. But there isn't much research available on ship monitoring. Due to the growth of the fishing industry and marine sector,

this system is now becoming more and more necessary. Fishermen often go 65 nautical miles (nm) offshore, thus their only other options for communication are satellite phones or emergency transponders. However, since this equipment is expensive and many people cannot afford it, they are left with little choice but to rely on self-safety measures. As the fishing boats lack sophisticated systems to alert the transport vessels, they often meet with accidents because these tiny vessels are frequently not picked up by the RADAR systems of large transport vessels (often at night). Many shipping businesses are attempting to find answers to this issue since they are aware of the pressing need for this sort of system. To help with this, a system has been suggested that would identify nearby ships or other foreign objects that move unusually. According to boat design, ultrasonic sensors are put on boats in the proposed system to ensure that they cover the greatest possible area. If an item is found, the boat is informed of its approximate distance [4], [5].

The ESP module is used for communication, and it displays the relative distance between the ship and the Thingspeak server. After that, it sounds like an alert aboard the boat so that the skipper may manually operate it. To create a system more interactive, the system gives the direction to move following the relative distance taken from Thingspeak and input into the Matlab SVM model, which has a 98% testing accuracy. In any case, if the boat is not manually driven, the system automatically takes over the motor and attempts to prevent the crash. The motor will revolve in the opposite direction to regulate the ship's speed, producing the opposing push and causing braking to occur. If the ship is no longer in danger, some reset time is provided in between this step to reset the controller and switch the controls to manual. Arduino is used to control all of the aforementioned control actions to display the system prototype model.

Many nations now mandate that commercial fishing boats carry along an observer, who verifies that the crew isn't going over their catch quotas, in an attempt to protect the world's seas from overfishing. However, that observer takes up cabin space on the boat, needs pay and is probably not treated with a lot of warmth by the crew. But last month, a Spanish purse seine became the first tropical tuna fishing boat in the world to experiment with something novel: an electronic monitoring system. The EM Observe system, created by Archipelago Marine Research, is now in widespread use in British Columbia, Canada, where the firm is based. Multiple sensors positioned around the boat, such as hydraulic and drum rotation sensors that are activated when the net is being brought in, enable EM Observe to detect fishing activities. Then, video cameras document the species, size, and quantity of fish caught, and a GPS logs the place and time of each catch. All of the data is kept on an onboard computer, which broadcasts it once every hour via satellite. The hard disk of the boat may be removed when it docks the next time, giving fisheries staff access to all the information in one location for examination. The company's EM Interpret software arranges everything into a single timeline presentation reflecting the whole fishing trip to assist make sense of the terabytes of data that may be on that disk.

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## CHAPTER 8

### FISHERIES MONITORING

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The world's marine fisheries generate wholesome food for billions of people, support tens of millions of employees, and make a significant contribution to the economic growth of many nations. Even though it is becoming evident that more seafood and livelihoods will be required as the world's population rises to provide food security and help pull people out of poverty, the productivity of wild fisheries seems to have plateaued or even decreased. Recent research suggests that fisheries could produce much more food and profits while also increasing the amount of fish left in the water to maintain the health of ocean ecosystems, if catches in all of the world's fisheries could be adjusted to meet scientifically determined targets and if fishery economics could be optimized. A key strategy for achieving many of the Sustainable Development Goals of the United Nations, such as eradicating poverty and hunger, safeguarding marginalized groups, fostering sustainable livelihoods, and preserving ocean ecosystems, is to manage fisheries so that they realize their full potential. The general absence of fisheries monitoring is one of the major obstacles to realizing this potential. A greater number of fisheries will need to be monitored, scientifically evaluated, and managed based on data and science to improve fishery performance in terms of seafood output, profitability, livelihoods, and conservation.

Additionally, it will call for effective fisheries governance that creates incentives for observing science-based restrictions. The catch of roughly 7000 fisheries is monitored to some extent, and about 600 fisheries are scientifically analyzed and managed, but there are at least 10,000 fisheries around the globe. This means that the vast majority of fisheries are likely not monitored or controlled in the same manner. Even though more fisheries are being watched over in some fashion as a consequence of various local laws and international agreements, the watch is often restricted to position tracking through Automatic Identification Systems (AIS) or Vessel Monitoring Systems (VMS) (AIS). Many fisheries do not keep track of whether or not catch restrictions, which are crucial for sustainability, are being followed. Numerous fisheries are not even maintained, much less observed. Widespread unlawful fishing is the consequence of this lack of management and oversight, as well as other problems including inadequate judicial and law enforcement institutions. Illegal fishing causes overfishing, habitat devastation, the loss of incalculable millions of seabirds, sharks, turtles, and other ocean animals, as well as the theft of billions of dollars from genuine fishermen.

To fully account for fishing activities, EM systems use cameras, gear sensors, as well as sophisticated data analysis. This results in some advantages, including high compliance rates, supporting documents of sustainable fishing practices, as well as access to markets that demand high standards of transparency but also sustainability. Less than 1% of fishing boats worldwide are, however, vulnerable to EM because of a variety of issues, such as a lack of infrastructure, high



expenses, and a lack of ability to process and interpret EM data. The author goes into further depth about these limitations and offers advice on how to build and execute EM systems by getting around them. To demonstrate how monitoring programs employing technologies may be created for any fishery, this paper will cover additional monitoring technologies that can be particularly helpful in fisheries that lack the ability, infrastructure, or income for typical EM systems. To increase fisheries yields, revenues, and conservation performance, we concentrate on technologies that are beneficial for tracking compliance with fishing rules including catch limits, effort limitations, and the usage of restricted areas. To do this, we looked at the history of technological usage in fisheries around the world. Some of the technologies we discuss in this study may be used as EM system components. The majority of the components of an EM system are currently included in some very affordable systems. To describe the circumstances essential for high levels of compliance and how to get through obstacles to the general use of technology to promote compliance, we also relied on the literature study and our experience dealing with similar fisheries across the globe.

The fact that there is no magic solution for implementing fishing restrictions should not be overlooked. We cannot assume that the implementation of technology will lead to high levels of compliance in every fishery because compliance depends on people with the integrity, knowledge, and resources to use the monitoring and surveillance data to enforce the regulations as well as on fishers' perceptions and attitudes. Additionally, there are a few prerequisites that must be met for technology to be effective in enforcement, most notably data management systems, and statutory requirements. Using existing or soon-to-be-available technologies, we explain some of the biggest fisheries enforcement difficulties in this paper. In order to increase the possibility that monitoring and enforcement programs will be adopted more broadly, we also analyze challenges to the adoption of monitoring technologies and outline a human-centered design approach meant to identify and remove these barriers in particular fisheries. Through four desk exercises with local experts for a shellfish fishery in Mexico, a finfish fishery in Chile, an artisanal hake and tuna fishery in Peru, as well as a blue swimming crab fishery in Indonesia, we demonstrate how this method may be utilized to create a monitoring program. We conclude by summarizing and discussing the key takeaways from the world's experience with monitoring technology thus far. Experience throughout the world in utilizing technology to enhance fisheries compliance

## **DIFFERENT TYPES OF TECHNOLOGIES**

Utilized to increase adherence to fishing laws and is widely defined to encompass both software and hardware used for data analysis and visualization. Some of them only let fishermen to self-report catch, effort, and other statistics, producing a data stream that may or may not be trustworthy and often requiring an audit by observers or onboard cameras. From fishery to fishery, monitoring objectives differ significantly, and as a result, so does the technology used to accomplish them. For instance, technology must be used that can provide data that can fulfill standards of proof in court if monitoring data are to be utilized to prosecute unlawful fishing operations. We have highlighted some common compliance concerns and described various tools that may be beneficial for tackling them, despite the reality that different fisheries will differ greatly in their monitoring requirements and capabilities. This is simply an illustration; to choose the suitable technology,

each fishery should follow the design process indicated in this paper. Although many additional technologies are being developed and might soon be accessible, we have only discussed those that are already on the market. This is why it's crucial to get the advice of a technology specialist when creating any monitoring system that makes use of technology.

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## CHAPTER 9

# SURVEILLANCE, CONTROL AND MONITORING

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In a nutshell, monitoring, control, or surveillance (MCS) is all about ensuring that fisheries management procedures are followed. Of course, this is a pretty rudimentary method, but when the components are examined, we can see that they all work to achieve the following objectives: While surveillance utilizes this information to make sure that these regulations are followed, monitoring collects data on the fisheries to help in developing and evaluating suitable management strategies [1], [2]. If a more exact definition of MCS is needed, it should be noted that the following definition was created by an FAO Expert Consultation in 1981:

- **Monitoring:** The ongoing need to measure the characteristics of fishing effort and resource yields; control: The legal terms under which resource exploitation may be carried out.
- **Surveillance:** The level and kind of observations necessary to uphold compliance with the legal restrictions placed on fishing activities.

This definition could be useful in understanding the many MCS components, but it is not one on which to focus. A definition by itself won't help a fishery manager who is trying to figure out how to approach an MCS solution or who needs to grasp the function of MCS within fisheries management. Understanding the main goal of MCS and having a basic understanding of the methods available to accomplish this is more crucial than a definition.

The goal of MCS is clear: to support effective fishery management by ensuring that the right controls are established, monitored, and followed. Technical measures and input and output controls are all regarded as the "control" elements of MCS, and they have all been discussed in detail in earlier chapters of this Guidebook. At the end of the day, this is what MCS is striving for, and regardless of the techniques, apparatus, parts, or systems used, the final result should assist in achieving this goal.

On the other hand, the possibilities and combinations that may be used with an MCS system are almost endless. Then, after the system is developed, there are even more options for managing the MCS system and organization. These options include a variety of separate or connected hardware components with varying levels of sophistication, different levels and types of human resources (both connected to and separate from the hardware), and a variety of implementation strategies, including everything from community-driven compliance programs to military-style enforcement. Therefore, the purpose of this chapter is to provide an overview of the most popular alternatives as well as some insight into the benefits and drawbacks of each option [3], [4].

When it comes to notions and functions in connection to the primary duty of the operations, compliance, or law enforcement division of the fisheries management authority, the word MCS is

frequently criticized as being too broad and unclear. This is mostly because the enforcement" component of the authority often focuses on the surveillance and enforcement aspects rather than the monitoring or control elements of MCS. Despite all the criticism the term MCS may face, it is now widely used globally and gives a broader viewpoint that is in line with some of the more contemporary trends and methods for addressing the problem of compliance and law enforcement. Since all of MCS's functions are discussed in this chapter, the reader is free to choose the ones that apply to their demands or operating situations [5]. For this reason, the name "MCS" has been used (i.e. who performs the tasks e.g. enforcement personnel, scientists, or administrators is not specified, but the tasks are).

## **HISTORICAL BACKGROUND**

It is interesting to quickly discuss the history of MCS and why for many fisheries management authorities the MCS component of their organization may be relatively young before we go deeper into the methods available today. In the early days of fishing, there often existed some kind of informal community or tribe management structure, and this would typically entail making sure that fishermen followed certain established rules of conduct. The optimum method to manage a fishery or water region that was under the "authority" of one social group was determined by these unwritten rules of conduct, which were based on local knowledge, philosophy, and superstition (community or tribe). If more social groups moved into the region, informal standards of conduct would once again govern how to proceed; if they were insufficient, small or large disputes would occur. However, the necessity for more formal and intricate MCS systems is a relatively recent idea that is closely related to the UNCLOS and the creation of Exclusive Economic Zones (EEZs). Before this, it was possible to see most fishing operations in territorial waters from the beach, which made MCS operations simpler.

The MCS systems created for the new EEZs served effectively as the fisheries management's implementing arm, mainly to make sure that control measures, once agreed upon and enacted, were properly put into practice. Although most MCS systems still perform this core function today, a much bigger and more connected role for MCS is emerging as a result of the integrated approach to fishery management that is supported by numerous international instruments, particularly the FAO Code of Conduct for Responsible Fisheries. MCS strategies now need to provide information that is essential to the assessment of various management measures to support the creation of management plans (and, by extension, control measures). Instead of continuing the previous emphasis on the enforcement of regulations, MCS systems are actively promoting fishermen's compliance via user involvement. In many regions of the globe, these two new developments are altering the MCS approach and bringing it closer to other areas of fisheries management as well as the fishing communities.

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## CHAPTER 10

### MCS'S FUNCTION IN FISHERIES MANAGEMENT

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Because it is often believed that excellent fisheries management is equivalent to good science, MCS concerns are frequently disregarded when management strategies and plans are being developed. That is to say, the requirement to effectively execute these measures to acquire a high degree of compliance by the fishermen was disregarded as long as appropriate scientific research and modeling supported the choice of management goals and methods. However, as a result of numerous ineffective management regimes that were primarily based on scientific assessment, the need for a more balanced approach one that views adherence to conservation-based measures as crucial for the effective management of fishery resources is becoming increasingly evident and well-liked. The MCS is one of these systems. The developing image in contemporary fisheries management is one of the interconnected and interoperable systems that give feedback and checks to the management approach.

Therefore, MCS strategy, planning, and operations are being given a far more important and integrated role at the fisheries management table under modern fisheries management. For instance, enforcement agents now actively engage in the creation of management plans and often attend consultative sessions with the industry in Canada. It is nevertheless evident that when the fishery's goals are selected ecological, biological, economic, or social, MCS concerns will seldom be relevant since the goals are linked to the general direction set by national or fisheries policy. Nonetheless, several MCS-related factors should be taken into account when discussing potential management strategies including the choice of the management measures that will be used to carry out these goals. To make sure that the MCS concerns are taken into account while reviewing any proposed plans, the MCS representatives should make sure to raise the following questions:

- What are the practical requirements necessary to put the management measures into action, and are they readily available? This should be seen from the monitoring, surveillance, compliance, and enforcement points of view.
- Any prior records of management measure success or failure should be evaluated (ideally quantitatively, but even qualitatively if no data are available), and the findings should be taken into consideration in light of any proposed;
- What are the motivating elements that will promote compliance as opposed to demanding enforcement, and what are the development needs for these? Are they realistic?
- The degree of compliance necessary to support the management plan should be taken into consideration given the impact that non-compliance (i.e., breaches of the established controls) would have on the status and viability of the fishery;

- What are the financial and resource costs of these management measures and/or non-compliance? Who should bear these costs from a financial standpoint the government, business, or both?

Illegal fishing and related activities have the potential to impair the execution of management plans and, in extreme circumstances, the rational utilization of the resource. Because of this, COFI created and approved the FAO International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported, and Unregulated Fishing in March 2001. Furthermore, a management plan that cannot be adequately executed, no matter how straightforward, might harm the confidence of the fisheries management authority and harm the management of other fishery resources. Therefore, it's crucial to make efforts to guarantee that management strategies can be effectively put into action and that non-compliance is limited to a manageable level.

To limit catch levels, for instance, total authorized catches (TACs) mandate that all landings be tracked and captured by species be reported in almost real-time (e.g. through logbooks and sampling or a complete landings monitoring program). Additionally, appropriate measures must be taken to stop the target species from being discarded at sea and from being transhipped without being recorded. Therefore, the question of whether the MCS organization can execute these necessary checks or if it can be evolved to do so must be raised. Another example may be efforts to regulate the number and fishing capacity of boats. Although effort controls are often less costly to establish than output controls, they nevertheless need precise fleet registration, careful fleet performance monitoring, and constant attention to any operational or technology advancements that can have an impact on efficiency. Even if we take into account some of the most basic control measures, like closed seasons or closed areas, these still require the ability to monitor the closed times and areas.

It is important to take into account both what MCS demands from management plans as well as the expectations that fisheries management plans have of MCS. To build MCS systems to the proper levels and at the right cost, unambiguous management statements are necessary. MCS operations must be related to specified management goals. Information on management priorities, management practices, and resource availability will also be required in addition to management goals.

The scientific section analyzes the impact of management measures on the fish stock and fishery, while the MCS and scientific sections both provide data necessary for the analysis, and the MCS section includes information on how compliant the fishers are with this management measure. This is an example of a link between monitoring and scientific research. For instance, if a fishery has a mesh limitation of 150mm in place, the science department will assess the impact this has on the catch composition possibly using information collected by the MCS section. Through modeling, this data is then extended to provide estimates of fish size and age for the total catch of that species, although naturally, these projections assume that the 150mm mesh constraint will be strictly adhered to. Therefore, it is the responsibility of the MCS organization to either guarantee that the management measures are followed or, in a more practical manner, to tell the scientists of the expected amount of non-compliance. With this knowledge, the scientists may modify their models to more accurately represent the size distribution of the fish captured.

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## CHAPTER 11

### STRATEGY AND PLAN FOR FISHERY

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The following elements, although not critical considerations, may help a manager in building the strategy even if they are not necessary for designing an MCS strategy.

- If the fishery is to see any overall cost benefit, an MCS plan is essential. To decide what activities to plan for, what to discontinue, what to upsize, and what to downsize, an assessment of the economic inputs and results from a fishery is essential. This is because it might be difficult to quit an activity or start one inside an existing organization.
- The requirement for a fluid strategy and plan that can respond to the dynamic nature of fish, and fishers, as well as fisheries or how to manage this flexibility within a system of yearly planning for financial, human, and material resources, are two challenges that MCS managers must overcome. In more conventional MCS systems such as those involving vessels, aircraft, and observers, one solution is to determine which activities may require the most flexibility and to always plan these with room for adjustments and changes, as well as, if practical, to incorporate a plan review at the halfway point of the year. A more recent approach is to implement an MCS system that makes use of more adaptable current components like a Vessel Monitoring System (VMS) or remote sensing.
- A helpful strategy for organizing efforts is to divide them into two main categories: monitoring and compliance, which includes stakeholder discussions and sector awareness initiatives, and enforcement, which includes police and deterrent.  
Since a fishery's economic return is typically one of the goals, it's interesting to think about things like how achieving 100% compliance might be more expensive than the economic returns, as opposed to how 70% compliance might be both doable and affordable, and how the remaining 30% non-compliance might be planned for in the management plan and thus not pose a threat to the self-sustaining use of the resources. The key takeaway is that a balanced and sensible approach must be used when creating a monitoring or surveillance plan. It should be mentioned as well that the desired degree of compliance is a strategic choice that must be made uniquely for each fishery.
- Effective fisheries management requires both short- and long-term strategies, and all plans, policies, and strategies must have the same goals.
- A well-designed plan will take into account comparing the MCS system's performance to the goals.

The majority of the bigger fishing countries depend on some amount of consultation with resource users; nevertheless, while creating the MCS plan, a critical consideration is what level of engagement is permitted and encouraged. Organizations interested in interests other than fishing, such as environmental groups, should be included in the process. Conflicts between various

interest groups should be resolved as part of long-term initiatives. Finally, the following straightforward questions must be addressed whenever a strategy is being revised or developed.

- What is necessary for the fisheries that you are managing?
- In terms of the legal system, what is possible?
- In terms of the resources at hand, what is reasonable?
- What can be implemented realistically while taking the political climate and the many stakeholders in the fisheries into account?

Imagine managing a large-scale artisanal fishery with little information on catch or effort, but with the knowledge that declining catches and heavy exploitation in some areas had led to the introduction of a new minimum mesh regulation for certain gear, a ban on beach seines, and two designated no-fish areas. This is an example of a straightforward strategy and plan for the MCS system. The country only has a little budget to manage the fisheries and a national job program. The fishery is important for local employment and food security even if it has little commercial value. The MCS organization may get this information, which may or may not be more specific, through a management plan.

A suggested strategy for implementing these measures would be to concentrate on two parts in the short term: data gathering and encouraging voluntary compliance via community self-monitoring and fisher responsibility developed through an awareness campaign. Part-time local employees should be hired to gather the data, and managers should assist them. These supervisors would also oversee the awareness campaign and the community self-monitoring program. The long-term strategy would look for ways to provide fishermen with other jobs via the tourist industry. By year three, the goal of the plan is for more than 80% of fishers to adhere to the gear and area limitations; by year three, quality catch or effort data should be easily available for stock assessment; so by year five, 5% of fishers should have alternate sources of income identified.

The strategy would then get operational information from the plan. For instance, in month 1, 20 data gatherers from different sites in the fisheries have to be hired. A team of three inspectors from the MCS organization will educate the data collectors during a one-week training session. This team will assist the data collectors and also develop and carry out an awareness campaign. In the second month, a frame survey will be conducted with the help of the data collectors and supervisors, and there will be first introductions and information sharing with the neighborhood. The frame survey results will be used to construct a sample schedule for data collectors in month 3, and further training will be provided on sampling procedures, form completion, etc. during this time. The data collectors will sample once a week at their designated beaches by month five. The supervisory team will often visit data collectors to collect forms and go over the job. The awareness campaign will begin in month 4 with community gatherings and radio broadcasts on the need for conservation in fisheries, and so forth until an annual MCS plan is formed.

The aforementioned example illustrates the relationship between the three levels management plans, MCS strategy, and MCS plans while being very simple and constrained. In the MCS solution, it is crucial to have both a strategy and a plan because they help in various ways to ensure that activities, which are sometimes quite isolated and divided, have a sense of aim and purpose. Therefore, an MCS strategy is required to provide the organization with precise guidance about

priorities, resource allocation, and human resource development, while the plan actualizes this in practice. Building and training an organization to a level of good performance may take years, which highlights the necessity for long-term strategy and thorough planning.

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## **CHAPTER 6**

### **NAUTICAL BORDER ALERT SYSTEM FOR FISHERMEN**

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This cross-border brutality is mostly due to the difficulty in identifying the maritime boundary between the two nations. To determine the fishing boat's or vessel's present position, we employ a GPS receiver. The current latitude or longitude data may be determined using GPS and are then supplied to the microcontroller unit. By comparing the current latitude and longitudinal data with the specified value, the controller unit then determines the current position. The technology alerts the fishermen when they are going to cross the nautical boundary based on the comparison's findings. The LCD will show the normal zone if the boat is in that region. Thus, they can demonstrate that the boat is in its usual location. The LCD shows a warning zone if it continues moving and enters the zone. The alarm will sound and the boat's engine speed will be automatically reduced by 50% if the fisherman ignores the warning or fails to view the display and continues to proceed. If the boat enters the zone closer to the restricted zone, as well. If the fisherman ignored the warning and continued to move, the boat would enter a limited area. The alarm would continue to beep as before, and once it reached the restricted area, the fuel supply to the engine would be controlled to turn off the boat's engine.

#### **MARITIME BORDER ALERT SYSTEM IMPLEMENTATION**

This report suggested assisting small-scale fishermen with safe marine navigation and then discouraging them from crossing international borders. GPS is used in the data gathering equipment, which provides location information depending on the position of the boat and transmitter. The processing unit requested information about the nation's borders that were previously known and then compared that information to its present location. The controlling unit will decide whether to warn the coast guards and fisherman.

#### **HEART RATE MAY BE MEASURED PASSIVELY USING AN RFID TAG AND AN ECG SIGNAL**

Battery-free passive RFID (Radio Frequency Identification) tags operate off of the wireless power generated by an RFID reader. Similar to barcodes, RFID tags have traditionally been employed as product identification tools. These tags must be able to communicate sensor data together with the tag ID to be utilized in sensor networks. An RFID tag may be used as a one-bit communication device in its most basic form by turning it on and off and letting an RFID reader determine its status. When the tag is active and when it is not a comparable gadget with two RFID tags. Modern RFID tags can send additional bits of optional data in addition to the tag ID by default. To digitize and incorporate the sensor data with the tag ID, additional equipment, such as analog-to-digital converters (ADCs) and microcontrollers, is needed. These extra parts not only make the system bigger but also increase the amount of electricity it needs. The fact that such systems need a lot of

sent data redundancy to be reliable is another disadvantage. For instance, 92% data overhead is needed for the electroencephalogram (EEG) system presented.

### **ANDROID-BASED ALERT SYSTEM FOR FISHERMEN AT BORDER CROSSINGS**

People living near the border may make extensive use of the program to locate the best route to their destination. The warning will be sent to the border security personnel who serve as the server for all other equipment used by mariners. The program will alert users to the location of the devices and warn them of any problems brought on by enemy forces in ships that are connected to the server. This is mostly processed for Tamil fishermen who engage in fishing. The Global Positioning System (GPS) is utilized by the program to give latitude and longitude data, which is used to track devices. The system only makes use of device-based tracking, which prevents system failure due to network issues. The tracking in this case is entirely dependent on the device, not the signal or network being utilized at the time.

### **ANDROID-BASED LOCATION-BASED SERVICES**

Originally, only voice communication was supported by mobile phones; however, nowadays, voice communication is merely one function of a mobile phone. There are additional elements that are the main focus of attention. GPS services and web browsers are two of these important components. Both of these features are already in place, but due to proprietary problems, only manufacturers have access to them; consumers are not able to directly access the mobile hardware via the system. However, with the introduction of open-source Android-based mobile phones, users may directly access the hardware, create bespoke native programs, program additional hardware elements like cameras, and construct Web and GPS-enabled services. We shall examine the facilities in this article. Android platform is available for building LBS services.

### **IMPLEMENTATION OF AN RFID AND GPS COMBINATION STRATEGY IN A FISHER BOAT TRACKING SYSTEM:**

Unprecedented remote monitoring capabilities that might be useful for applications like industrial control, environmental management, and defense could be provided through wireless sensor networks. One of the most fascinating technologies, radio frequency identification (RFID), is revolutionizing business practices by boosting productivity and profitability. Although it is described as a conversion of current barcodes, the new technology offers considerably more possibilities, including the ability to scan individual serial numbers for each object from a distance of several meters. These networks allow enhanced knowledge of processes and surroundings by ongoing monitoring of a wider range of metrics, and they are easier to implement than wired salutations. This project uses RFID to demonstrate the development of wireless sensor networks.

### **CURRENT SYSTEM**

The current technology makes use of a GPS receiver to determine the boat's present location by receiving signals from satellites. The current technique is used to locate a country's boundary using its latitude and longitude, not only between Sri Lanka and India but everywhere in the globe. The specific layer level, or boundary, may be preset and saved in the memory of the microcontroller. The current value is compared to established values, and if they are the same, the specific function,

in this case, the microcontroller instructing the alarm to buzz, will be carried out promptly. Additionally, it employs a message transmitter to deliver messages to the base station that keeps track of the seafaring vessels. The technology gives a signal to both coastal guards and fishermen.

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