DETECTION AND MONITORING SYSTEM

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March 2023

CIIR BOOKS AND PUBLICATIONS

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Preface

Condition sensing devices enable continuous real-time monitoring of processes and systems, enhancing availability and reliability. High-quality sensors are used by infsoft to provide solutions for any need or application, including people counting, object detection, energy conservation, and indoor air quality monitoring. Get to know different condition sensors and discover a variety of suitable applications. Realizing occupancy-adaptive systems in interior settings requires accurate presence detection of people or items. Depending on the application, different technologies are suitable for presence monitoring.

Based on radiant heat that objects emit or reflect, infrared thermopile sensors identify presence and detect movement. Both moving and still objects, as well as the direction of movements, can be picked up by the sensor. This creates possibilities for people counting, ambient assisted living, hot spot monitoring, energy conservation, and many other things. Even in the presence of fog, grime, and dust, ultrasonic sensors can identify persons, objects, or fill levels with extreme accuracy across a broad range of distances. Possible applications include vehicle detection, factory automation, people counting, and fill level control.

Classic presence detectors based on passive infrared (PIR) detect physical presence indoors and are ideal for offices, public buildings, hallways, storage areas and washrooms. They are characterized by simple construction, low maintenance requirements, and a convincing price/performance ratio. One of the most prevalent uses is presence-dependent and energy-saving lighting control. Motion sensors monitor the motion, acceleration or vibration of a device or system. Among other things, they can be used for shock monitoring, occupancy sensing, and fall detection.

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CHAPTER 1

INTRODUCTION TO FOOD QUALITY DETECTION AND MONITORING SYSTEM

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Any living thing must consume food to maintain the energy needed for survival. The body is kept active and healthy by the nutrients and energy from a nutritious diet. To boost production, pesticides are often used in agriculture; nevertheless, these pesticides also significantly contribute to food contamination. When exposed to pesticides, eating poor food is like a courting illness. Sickness, obesity, and vitamin deficiencies are caused by bad eating. Young people nowadays are engaged in living healthy lifestyles and are worried about their physical fitness. As a consequence, keeping fit depends greatly on nutrition quality [1]–[3].

Another significant problem in modern life is food poisoning, which is the cause of many illnesses. There has been a lot of research done on food quality. Scientists are working to live up to public expectations and are mostly focused on the types of bacteria present in food. Technology and scientists have significantly influenced how we see the quality of food. It is obvious from the present scenario that we need a device that gauges food quality.

Our system evaluates the quality of the meal using the PH sensor, temperature sensor, and scent sensor. The quantity of harmful gases in food is measured using the mq3 sensor and the MQ135 odour sensor. By keeping an eye on variables like temperature, humidity, and potentially harmful gases, these gadgets keep an eye on the quality of the food. Our project's objective is to design a prototype for gathering information from intake sensors. The necessary output for the system is shown on the screen.

Any contamination that develops through storage or chemical reactions might taint the food we consume. Numerous viruses and bacteria may contaminate food, which can result in several different food-borne diseases. The nor virus, for instance, is a very infectious virus that is transmitted by tainted food or drink. Every year, the majority of deaths globally are caused by food poisoning. It is crucial to eat nutritious foods in daily life. The goal of this system is to create an electronic gadget that can identify spoiled food. To examine the food's condition, monitor its quality, and guard against serious illnesses brought on by unhealthful eating [4]–[6]. One of the areas with the cleverest appliances is the kitchen, and a refrigerator is one of those gadgets. The term "embedded device" refers to the collection of hardware and software that joins the system's artificial sensors and actuators. This appliance's main uses include keeping fruits, vegetables, and other items. Any old system may be transformed into a smart, cost-effective machine by utilising a smart quality management module. A smart system compares the food's state, such as amount, foul smell, and other factors. The removal of food spoiling, reduction of sickness, and improvement of contemporary human living will be the significance of this study.

IOT FOOD QUALITY DETECTION TECHNOLOGY BASED ON ARUDINO

The majority of food-borne infections, which result in more hospital admissions and fatalities, occur in India. We are creating a project named food detection system utilising embedded because of this. It is used to determine how fresh food, such as meat, fruits, and vegetables, is.

ISBN 978-81-962230-3-8 March 2023

For example, a temperature sensor measures the meal's temperature, a pH sensor measures its salt content, and a normal pH value is recorded on an IOT server and compared to the item in question. The food's gas level is checked using a pollution sensor, which alerts users to normal or problematic conditions. Using image processing, the freshness of the fruit is assessed while the food's colour is tested. To prevent food-borne illnesses, purchase wholesome foods, and increase a person's income, we are effectively evaluating food quality in this manner.

AN EFFECTIVE FOOD QUALITY AND FRESHNESS DETECTION SYSTEM

The Internet of Things-based food quality tracking system is a monitoring and management information system that combines radio frequency identification, intelligent database technology, food safety technology, network technology, and other useful high-tech methods. Our bodies get fuel and energy from the food we eat, which enables us to carry out our daily tasks. The best method to stay in shape is to eat a balanced, fresh diet. Food products stored at room temperature quickly develop germs and alter chemically. Eating improper food may result in several foodborne illnesses that might be harmful to our health. Using biosensors and electrical sensors, this embedded system seeks to determine the quality and freshness of food. a sophisticated technology that can determine if common household foods like dairy, fruits, and other items are still fresh. To create a practical food freshness detector, hydrogen, moisture, and gas sensors were identified and chosen. This assures food freshness and indicates whether it should be consumed or thrown away. The device's findings of inspecting food items are shown via a web application. If the system does not provide effective results, users may submit a complaint and reviews on the website by completing an online form.

FOOD QUALITY MONITORING SYSTEM

Maintaining food quality has grown to be one of the world's top problems. According to recent assessments, the environment where the food is kept is not properly maintained, resulting in the loss of around half of the food commodities produced. This necessitates the use of technology to highlight the situation and provide answers. In this paper, a food quality monitoring system (FQMS) for fruit and vegetable storage facilities is discussed. This system uses the Internet of Things (IoT) to monitor stock levels, control environmental factors like temperature, humidity, and lighting to create an ambient environment and notify stakeholders when food is going bad or if there are any fire hazards. The stakeholders will get the aforementioned information through an app where they may create profiles and maintain track of the products' safety and hygienic practices.

A FOOD MONITORING SYSTEM BASED ON IOT FOR WAREHOUSES

Producers, intermediaries, merchants, and consumers all utilise warehouses. Farmers suffer a significant loss every year as a result of the issue of warehouse storage needs. This is a result of faulty food storage monitoring and inadequate refrigeration equipment. Traditional storage techniques were introduced, forcing a labour-intensive and time-consuming large-scale manual approach. The smart IOT-based food monitoring system in warehouses presented in this research employs a Raspberry Pi and a variety of sensors to continually monitor the numerous elements that may impact the quality of the food. Data visualisation is made easier with the usage of The Thing Speak as a cloud. Mysql is used to manage a database, and a login page is made to assist the warehouse administrator with ongoing temperature and humidity monitoring.

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ISBN 978-81-962230-3-8 March 2023

CHAPTER 2

EMBEDDED SYSTEMS

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Embedded systems must be reliable and capable of handling any circumstance without the need for human involvement. Memory space - On embedded systems, memory is constrained, and thus you must compress the programme and the data to fit the available memory. Program installation: To get your programme into embedded devices, you'll need specialized tools. Power use - Since portable systems must be powered by batteries, their software must be power-efficient [1]–[4].

Processor hogs: The response issue may be made more difficult by computation that consumes a lot of CPU time.

- Cost: Since software often runs on hardware that is only sufficient for the task, lowering the cost of the hardware is a consideration in many embedded system initiatives.
- Embedded systems have memory and a microprocessor/microcontroller. Some feature a network connection or a serial port. Typically, they lack disc drives, keyboards, and displays.
- Embedded software for the military and aerospace
- Applications for communication
- Software for industrial automation and process control. Understanding how to use sophisticated apps.
- A shorter product design period.
- Processing of ever-growing volumes of data in real-time.
- Autonomous, intelligent sensors.

REAL-TIME SYSTEMS ARE CLASSIFIED

- RTS must react to situations within a certain time frame.
- A correct response sent after the deadline is incorrect.
- Software Architecture for Embedded Systems explained
- Software architecture comes in a variety of forms that are often used.
- Basic Control Loops
- The software in this architecture consists just of a loop.
- Each subroutine that is called by the loop controls a specific piece of hardware or software.

SYSTEM THAT CONTROLS INTERRUPTIONS

Some embedded systems are primarily controlled through interrupts. This implies that various sorts of events serve as triggers for the system's duties. For instance, a timer operating at a set frequency or a serial port controller receiving a byte might cause an interruption. The

ISBN 978-81-962230-3-8 March 2023

development of food quality detection used one or two simple sensors in the past, each tested for a distinct item. Additionally, we are unable to test liquid items. Smarter devices that may simplify life are still being used as a result of human improvement in technology and hectic lifestyles. Smart kitchen equipment at home provides a safe and productive living [5]–[7].

BUZZER

The suggested system works by using several sensors to evaluate the quality of food. For example, a temperature sensor is used to measure food temperature, a pH sensor is used to measure food salt content, and a normal pH value is stored in the controller's flash memory and compared to the food. The food's gas level is checked using a pollution sensor, which alerts users to normal or problematic conditions. By doing so, we are effectively determining the quality of the food we purchase to prevent food-borne illnesses, eat healthily, and increase human wealth. Our idea aims to create a small, practical device that can identify nearby UN-approved foods and notify people about them. It is used at stores to purchase fresh foods like fruits and meat.

ARDUINO:

The Arduino Uno R3 is an embedded electrical microcontroller board. Based on the ATmega328 AVR detachable dual-inline package (DIP) microcontroller. Digital input/output pins are included (of which 6 can be used as PWM outputs and 6 can be used as analogue inputs). It may be programmed using the user-friendly Arduino computer software. The open-source Arduino platform is used to create electrical projects. A computer application known as the IDE (Integrated Development Environment) is used to create and upload programming languages to the physical programmable circuit board that makes up the Arduino. This software is used to write and programme the physical board.

With those just getting into electronics, the Arduino platform has become rather popular, and for good reason. The Arduino does not need a separate piece of hardware (referred to as a programmer) to load fresh code onto the board; instead, we may do so by using a USB connection, unlike the majority of earlier programmable circuit boards. Additionally, the Arduino IDE employs a condensed form of C++ that makes learning to programme simpler. Finally, Arduino offers a standard form factor that separates the micro-functionality controllers into more usable packaging.

Every Arduino board must include a port for attaching to a power supply. A USB connection from a computer or a wall power source (like this one) with a barrel jack termination may power an Arduino UNO. The barrel jack, and the USB connection. Additionally, we will upload code to the Arduino board via the USB connection. Our Installing and Programming Arduino lesson has further information on how to programme with Arduino. The Arduino's pins are the locations where wires are connected to build circuits, often in combination with a breadboard and some wire. Typically, they include black plastic "headers" that let us insert a wire directly into the circuit board. The Arduino features a variety of pin types, each of which is identified on the board and has a particular purpose.

GND: Abbreviation for "Ground." The Arduino has several GND pins, any of which may be used to ground a circuit.

Analog the pins on the UNO labelled "Analog In" (A0 through A5) are the Analog In pins. These pins are capable of reading an analogue sensor signal, such as one from a temperature sensor, and converting it into a readable digital value.

The digital pins are located across from the analogue pins (0 through 13 on the UNO). These pins may be used for digital output as well as digital input, such as determining if a button has been pressed like pointing an LED.

PWM You may have noticed that some of the digital pins have tildes () next to them (3, 5, 6, 9, 10, and 11 on the UNO). Although they function as standard digital pins, these pins may also be used for a process known as pulse-width modulation (PWM). Think of these pins as being able to replicate analogue output for the time being till we have a lesson on PWM (like fading an LED in and out). AREF is an acronym for analogue reference. We can generally leave this pin alone. The top limit for the analogue input ports may occasionally be adjusted to an external reference voltage (between 0 and 5 Volts).

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CHAPTER 3

DETECTOR AND SENSORS

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The water content of the soil is measured using a soil moisture sensor. To operate their irrigation systems more effectively, farmers need to measure soil moisture. By properly managing soil moisture throughout crucial plant development phases, farmers are not only able to produce crops with less water overall, but they are also able to boost crop yields and quality. Soil moisture sensors are used in a variety of fields than agriculture. To reduce overwatering and the off-site leaching of fertilisers and other chemicals, golf courses are increasingly integrating sensors to improve the efficiency of their irrigation systems. The module compares the soil moisture level with the predetermined threshold using an LM393 comparator conversely when the soil moisture deficiency module produces a low level. A moisture sensor, resistor, capacitor, potentiometer, comparator LM393 IC, power source, and status LED are all included in this moisture sensor module [1]–[3].

WATER DETECTOR

Two probes make up the moisture sensor, which measures the moisture content of the soil. The immersion gold coating on the moisture sensor probes prevents oxidation of the nickel. The sensor detects the resistance after passing the current through the soil using these two probes to determine the soil's moisture levels.

MOISTURE SENSOR

The four pins on the moisture sensor module are VCC, GND, DO, and AO. The analogue pin is linked to the moisture sensor, while the digital out pin has been connected to the LM393 comparator IC's output pin. It is quite simple to use a moisture sensor module with a microcontroller; the internal circuit schematic is shown below. Connect the module's Analog/Digital Output pin to the microcontroller's Analog/Digital pin. Connect the microcontroller's VCC and GND pins to its 5V and GND pins. The probe should then be inserted into the ground. The soil will conduct more electricity when there is more water present, resulting in low resistance and high moisture levels [4]–[6].

OPERATION OF PH

To assess whether a solution is acidic or alkaline, a pH metre is used. The hydrogen ion concentration in the solution is measured by pH. A solution with more H+ ions will always be acidic, whereas a solution with more OH- ions will always be alkaline. The measurement of a voltage is necessary for pH measurement using a glass pH electrode. The electrical potential provided by the hydrogen ion selective electrode (ISE) with glass membrane, in contrast, is based on the activity of hydrogen (H+) ions in the sample solution.

It is relatively simple to use a moisture sensor module with a microcontroller. Connect the module's Analog/Digital Output pin to the microcontroller's Analog/Digital pin. Connect the

ISBN 978-81-962230-3-8 March 2023

microcontroller's VCC and GND pins to its 5V and GND pins. The probe should then be inserted into the ground. The soil will conduct more electricity when there is more water present, resulting in low resistance and high moisture levels.

Liquid crystal display is referred to as LCD. It is a particular kind of electronic display module used in a wide array of circuits and devices, including mobile phones, calculators, computers, TVs, and other electronics. These displays are mostly favoured for seven segments and multi-segment light-emitting diodes. The primary advantages of adopting this module are its low cost, ease of programming, animations, and unlimited ability to show bespoke characters, unique animations, etc.

The fundamental idea behind LCDs is the employment of modules to let light travel from one layer (sheet) to another layer. The polarised sheet can transmit light through it because the modules vibrate and line up at a 90-degree angle. The molecules are in charge of displaying information for each pixel. The numeral is shown on each pixel using the light-absorbing technique. Molecules must move for the light's angle to shift to display the value. As a result, the human eye will see the brightness of the remaining portion, turning the dark portion into values and digits on the grid pixels. We can see that the area where light is absorbed will contain the data. The information will get to the molecules and stay there until they are altered.

- The following are the primary characteristics of this LCD.
- This LCD's working voltage ranges from 4.7 to 5.3 volts, and it has two rows with a total of 16 characters on each row.
- With no lighting, 1mA of current is being used.
- Each character may be constructed using a 5x8 pixel box, and the alphanumeric LCDs display both letters and numbers.
- The display has two operating modes, 4-bit and 8-bit, which are available in blue and green backlights.
- It shows a few custom-made characters.

APPLICATIONS:

Here are a few significant uses for liquid crystal displays (LCD)

- The cockpit displays of aeroplanes employ liquid crystal displays (LCDs).
- Calculators utilise it as their display screen.
- For using digital camera photographs that are shown.
- The primary use of LCD is in televisions.
- LCD screens make up the majority of the computer display.
- All laboratory equipment employs LCD displays for display, hence it is used in the instrument panel.
- All digital wristwatches employ LCDs as their primary method of time display.
- LCD displays are used in mobile devices. Additionally, video players make advantage of it.

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CHAPTER 4

ARDUINO SOFTWARE

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The use of Arduino is growing rapidly, and it is quickly replacing other microcontrollers as the platform of choice for students, hobbyists, and smaller businesses. To expand the capability of various Arduino boards, several other electronics PCB manufacturing businesses are getting on board and creating their variants of the boards in addition to "shields" and accessories. For free information, tutorials, and a language reference to better grasp the code and syntax, see the Arduino website. We will at the absolute least need an Arduino board to get started. Keep in mind that the Arduino software may be used with any Arduino (and the majority of clone boards). These five-minute lessons are built around the Arduino USB, which is presently the most popular variant if we're not sure what hardware to buy [1]–[3].

INSTALLING AND DOWNLOADING THE ARDUINO SOFTWARE:

- Download the most recent version of the Arduino software from www.arduino.cc.
- Download the ZIP file to your desktop (we can move or delete it later)
- It is practical to create an "Arduino" subdirectory under "Program Files". To achieve this, open the Explorer menu and choose "New"->"Folder" from the main menu by selecting "My Computer" -> "C:" (or the disc where the operating system is installed) -> "Program Files", then left-click once on the "programme Files" folder.
- To this new "Arduino" folder, extract the full ZIP archive.
- To launch the Arduino software, hit the Windows key (often located between the Ctrl and Alt keys on a keyboard) and the letter "E" simultaneously (there are other ways to access explorer as well).
- Open "My Computer" and then "C:" (or the disc where the operating system is installed) and then "Program Files" and then "Arduino." An executable file with the name "Arduino" in blue may be found in this folder. To make Arduino more accessible, left-click once, then right-click and choose "send to" -> Desktop (create shortcut).
- To launch the programme, double-click the icon on the desktop.

THE SOFTWARE INTERFACE FOR ARDUINO

The Arduino interface is comparatively "spartan." The first screen we see when the programme loads is a white window with a border in various hues of blue and blue-green (see below). Sketches are what Arduino projects are known as, and when we begin a new sketch, several extra files are also produced [4]–[6].

- Open the Arduino software by double-clicking the Arduino icon to connect to the board.
- Connect the USB cable to the Arduino with one end and the computer with the other.

ISBN 978-81-962230-3-8 March 2023

- The computer should identify the new device and inform us whether the installation was successful. There are two possible outcomes at this point. If we have an older board with an FTDI chip (for example, one based on a Duemilanove), Windows should identify it and we can go on to the next phase. We must manually instal the drivers if our board, like the UNO, has an ATMega chip to convert USB to serial.
- 4. Check to check which we have by looking at the primary processor chip on the board, which is often located between the pin headers.
- A list of potential boards will be sent to us. Choose a different board from the drop-down menu if we already possess one; if we bought a compatible board, the manufacturer should specify which board to choose.
- In the programme, choose "Tools" -> "Serial Port" -> COM # (keep in mind that if your computer has several COM ports, you'll need to visit Device Manager to find out which one is associated with your board.

ARDUINO SKETCH FLOW AND GUI,

As seen above, a message indicating that the compilation has been successful should appear in the message box, and the size of the machine language code that has been generated and is ready to be uploaded to the Arduino should be displayed in the console window. An error notice will appear in the message section, as shown below if any mistakes in the sketch code prevent the compilation process from succeeding.

ERROR DISPLAY

Additionally, the Arduino IDE shows the line of code that resulted in the mistake, making it simpler for us to identify the issue. To further assist, a more thorough error message now shows in the console window area. The next step is to upload the sketch to Arduino after we have it successfully compiled without any issues. Operating Program

We may now begin executing the sketch code because it has been uploaded to Arduino. The L and TX LEDs on the Arduino device, however, may have already begun to flicker after the upload procedure in the Arduino IDE was complete. That is a drawing in motion. The bootloader restarts the Arduino and launches the software after the upload procedure is finished. Using the serial monitor included in the Arduino IDE, we can see the output from the serial port on Arduino. Simply click the serial monitor icon (the magnifying glass symbol) on the toolbar or choose Tools > Serial Monitor from the menu bar. The output from the Arduino is seen in the serial monitor window, which appears. We could have seen that the blink count output resumed at 1 once we powered up the serial monitor. When we launch the serial monitor, it triggers the Arduino to be reset, which then launches the boot loader to reload the sketch and begin again.

Using the Arduino's Reset button, we may manually restart a running sketch. The Reset button is located in the upper-left corner of the circuit board of the Arduino Uno R3. To reset the Arduino, just press and release the button. The Arduino doesn't need to be connected to the workstation's USB port to function. Additionally, we may power the Arduino with an external power source like a battery pack or an AC/DC converter. Simply insert the po source into the Arduino unit's po connector. When a po is inserted into either the USB port or the po port, the Arduino Uno R3 immediately identifies it and launches the boot loader software to launch the sketch.

ISBN 978-81-962230-3-8 March 2023

OPEN THE ARDUINO SOFTWARE FIRST, THEN WRITE SOME CODE AND TEST IT

Once we are certain that the code is prepared and we want to produce the hex file, choose File from the menu above, followed by Preferences, as shown in the image. The LED Blink example is utilised in the above graphic, and its hex file will be generated. By checking this box, we are giving the Arduino software permission to display verbose outputs in the output panel that is located at the bottom of the programme and has a black backdrop. Therefore, we may also choose the upload option, but to get these output instructions, we must submit the code. To compile the code and get all the instructions as indicated in fig., click the compile button while selecting the compilation option. Now that we can see it, the graphic above shows that Arduino is providing us with verbose outputs in the form of multiple instructions in the dark area.

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CHAPTER 5

SOFTWARE FOR AN EMBEDDED SYSTEM

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Taking into account the shortcomings of current approaches and providing a solution by taking into account the fundamental needs of our suggested system. Taking into account the hardware requirements for the proposed system, we must choose the following components. Now that the hardware requirements have been taken into account, let's look at the programme needs. We may choose from a variety of coding, compiling, and debugging tools depending on the microcontroller we use. Based on our criteria, we must create the source code for the suggested system, build it, and debug it in the software. After finishing all of the hardware and software requirements, we must combine them to operate our system. To do this, we first burn our source code onto a microcontroller. Once this is done, we must link all of the input and output modules to the microcontroller following our needs [1]–[3].

COMBINING HARDWARE AND SOFTWARE FOR AN EMBEDDED SYSTEM

Software and hardware must be combined to make the software compatible with embedded systems. To do this, we must burn our source code into a microprocessor or microcontroller, a hardware element that manages all tasks performed by embedded systems following our code. Embedded system source codes are often written in assembly language, but processors only execute executable files [4]–[6].

There are three main processes involved in transforming your embedded software's source code representation into an executable binary image:

- An object file must be created by compiling or assembling each of the source files.
- To create a single object file known as the re-locatable programme, all of the object files created in the first step must be linked together.
- The relocation procedure, which assigns physical memory locations to the relative offsets inside the reloadable application, is required.
- A file containing an executable binary image that is prepared to execute on the embedded system is the result of the last stage.

APPLICATIONS:

- Embedded systems may be used for several things. Smart cards, telecommunications, satellites, missiles, digital consumer electronics, computer networking, and other niche uses of embedded systems are a few examples.
- Automobile embedded systems include the following: motor control system, engine or body safety, and assembly line robotics.
- Access to mobile and e-commerce
- Communications systems with embedded systems

ISBN 978-81-962230-3-8 March 2023

MOBILE TECHNOLOGY

We built the circuit following the schematic after first attempting to comprehend how our project worked. The project units' outcomes are shown. The image depicts how the circuit has evolved overall [7]–[9].

The created smart helmet is an intelligent and dependable piece of technology that costs little to produce and run but does not sacrifice safety. Additionally, it has several benefits over current accident detection and warning systems that mainly depend on information gathered from drivers' cellular handsets. Additionally, the majority of the systems on the market for automobiles are exclusively intended for four-wheeled vehicles. The automobile accident detection and alarm system described in this work send SMS messages to user-defined cellphone phones. The embedded system domain uses Arduino to create the GPS tracking and GSM alert-based method. The suggested car accident detection system provides a text message warning and may automatically monitor geographic information. The car sector will benefit greatly from the suggested technique.

- By utilising a modern, updated sensor, such as a nutrition sensor or calorie counter, the system may be enhanced.
- People who want to consume fewer calories may find calorie counting to be quite beneficial.
- This method may be improved in the future to calculate proteins, carbohydrates, lipids, calorie deficits, and many more nutrients in addition to food quality.
- We may update to an Android application for improved usage.
- Image processing is another option that we have so that we can quickly identify the food components.

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ISBN 978-81-962230-3-8 March 2023

CHAPTER 6

GPS LOCALIZATION IMPROVEMENT OF SMARTPHONES USING BUILT-IN SENSORS

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One of the most crucial functions of smartphones and mobile devices is location awareness and navigation. Mobile apps have become increasingly diverse thanks to personal management and location-based services. The most precise measurement system is GPS. GPS is one of the most significant service providers in LBS due to the shrinking size of the GPS receivers and indeed the incorporation of GPS with mobile phones. By the way, since GPS chips on mobile smartphones and other devices are often inexpensive, the performance of identifying accuracy is greatly influenced by external circumstances. Additionally, the accuracy of GPS is affected by the quantity of GPS satellites and is increased in areas where GPS interference develops, such as in a forest or next to skyscrapers [1]–[5]. A localization enhancement technique in GPS interference areas combines data from numerous smartphone sensors as mentioned in Figure 1. The proposed algorithm is implemented in a smartphone, and the effectiveness is verified on a college campus. The suggested technique performs quite well in open areas when the GPS receiver is reliable and outperforms employing solely GPS position data in GPS interfering locations [6].

Figure 1: Illustrated the GPS_GSM Based Tracking System.

One of the innovations that are used in a wide range of situations nowadays is GPS. One of the initiatives tracks your car and keeps an eye on it on a nearly daily basis. With the help of this surveillance system, you may see the presence and path taken by the car from any additional distant point. It also comprises an online application that informs you of the target's precise position. With the help of this technology, we can track a destination in almost any weather. Both GPS and GSM technology are employed by this system. This contains an experimental

hardware component that consists of GPS, GSM, an Atmega microcontroller MAX 232, and a 16x2 LCD. The new application is utilized to interface all important modules, and a client-side web application is also designed which is displayed in Figure 2. The main goal is to create a system that would be simple to deploy and provides a foundation for further enhancement.

Figure 2: Represented the GPS_GSM Based Tracking System with Google Maps.

Tracking System using GPS and GSM: Practical Approach

According to Figure 3, humanity's unrealized dream has been to be able to monitor, trace, and control something by anybody from any place on Earth. GSM and GPS have been well-liked in their respective context due to their utility; combining these technologies might show to be a flashy solution for many underlying problems. The goal of this study is to combine these two technologies into a single system and produce a useful application for both individual and vehicle monitoring. The two additional technologies can be used to integrate a multi-tracking system: first, GSM (Global System for Mobile), a set of standards for Second Generation (2G) technologies, and GPS (Global Positioning System), a geostationary navigation system made up of several satellite communications revolving around the earth.

The system's name, Multi-Tracking System, relates to its capacity to track and trace many moving objects sequentially. We may see the object's present position and other auxiliary features. For automobiles, live surveillance and tracing through GPS will be available, and its component components can be manipulated over the GSM network via SMS or GPRS. The whole computer will be constructed using Microsoft.Net Technology; C.net will be utilized for the components of the system and ASP.net for web-based aspects.

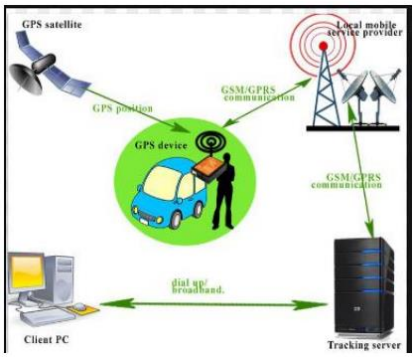

Figure 3: Represented A Predictive Controller for Mobile/Laptop Tracking and Security.

An android or laptop application called Predictive Controller for Mobile/Laptop Tracking and Security allows paired users to learn the locations of the other user's device. When a gadget suddenly disappears, a person goes missing, or in any other situation when it has to be traced, this program is used. This application tracks the device using the GPS module, and it connects to Google Maps to determine the precise position. Since a unique GSM module is connected to the handset as external hardware equipment, it may still be watched even if it is formatted. The Global Positioning System is used by GPS navigation technologies to pinpoint the exact location of the object to which they are connected and to constantly record the asset's position. A GSM modem contained within the navigational unit may be used to send the acquired location data to the smartphone of the user or a central database, internet-connected workstation, or storage space from the inside of the cartographic unit.

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CHAPTER 7

BLOCK DIAGRAM FOR TRACKING SYSTEM

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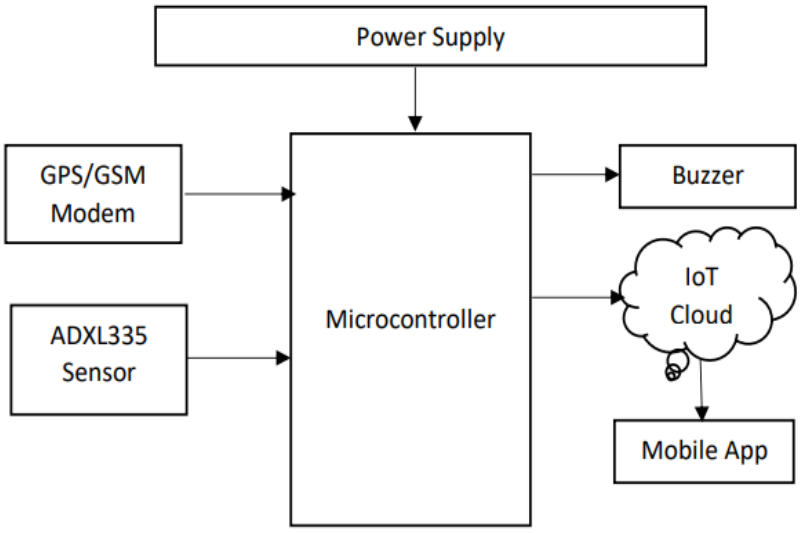
By removing all the drawbacks that exist in existing laptop tracking software, the Real Time Tracking and Alert System for Laptop via Application of GPS, GSM, Motion Sensor and Cloud Services for Anti-theft Purposes endeavours to locate the stolen laptop. The laptop's implanted tracking and warning mechanism will first be linked to a mobile application that utilizes an accelerometer, which can determine changes in movement along all three axes (X, Y, Z). Now, if someone attempted to steal the laptop, they would probably attempt to pick it up. As a result, the laptop would move, releasing the accelerometer. For GPRS connectivity, a SIM900 GSM chip will be used. To transmit and receive information to and from the server, the AT-command set will be utilized through a serial connection between of SIM900 chip and the microcontroller As displayed in Figure 1.

As a result, the mobile application of the subscriber receives a notice when an accelerometer is touched. Now, the owner may activate the emergency module in the laptop using the software platform if he or she considers that the laptop is in danger. The alarm will generate a noise that may be heard up to 10 meters away [1]–[4]. As a result, carrying the laptop while an alarm system is on which would present an extremely difficult and risky scenario for any burglar or thief. Now questions may surface regarding what might happen if the laptop's owner unwittingly sets off the alarm while attempting to manage it. The owner of the laptop will thus be in charge of setting off the alarm because they may remotely activate and disengage it using a mobile application on either phone or tablet. Through the GPS chip that is included in the laptop, the owner may also actively monitor the position or locations of his equipment.



ISBN 978-81-962230-3-8 March 2023

Figure 1: Represented the Block Diagram for Tracking System.

Requirements of Software and Hardware

Software

- Arduino IDE
- C++
- Mobile App(Blynk)

Hardware

- Microcontroller(NodeMCU)
- GPS & GSM Modem
- Motion Sensor(ADXL335)
- Buzzer

NODEMCU

The microcontroller known as the ESP8266 was manufactured by Espressif Systems. The ESP8266 as mentioned in Figure 2, is a self-contained WIFI networking system that also can execute a standalone programmer and serves as a bridge between current microcontrollers and Wi-Fi. This module has a built-in wired connection as well as a wide range of pin-outs. Similar to Arduino, you can easily flash the Node-MCU devkit by plugging it into your laptop using a micro USB wire. Additionally, it is right away breadboard friendly [5]–[7].

Figure 2: Represented the ESP8266 NodeMCU WiFi Devkit.

Specification

- Voltage:3.3V
- Wi-Fi Direct (P2P), soft-AP
- Current consumption: 10uA~170mA
- Flash memory attachable: 16MB max (512K normal)
- Integrated TCP/IP protocol stack
- Processor: Tensilica L106 32-bit

ISBN 978-81-962230-3-8 March 2023

- Processor speed: 80~160MHz
- RAM: 32K + 80K
- GPIOs: 17 (multiplexed with other functions)
- Analogue to Digital: 1 input with 1024-step resolution
- +19.5dBm output power in 802.11b mode
- 802.11 support: b/g/n
- Maximum concurrent TCP connections: 5

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CHAPTER 8

PIN DIAGRAM FOR TRACKING SYSTEM

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Since the ESP8266 module is effectively a Wi-Fi/Serial transceiver, the simplest technique to utilize it is via serial communications. This, however, is not practical. The only cool Arduino ESP8266 project, a customized variation of the Arduino IDE that you must run on the computer, is what we advise implementing instead [1]. This makes connecting the ESP8266 chip incredibly accessible because we'll be using the well-known Arduino IDE. Install the ESP8266 library by doing the methods below in the Arduino IDE environment [2]–[5]. Install Arduino IDE 1.6.4 or a later version. From Arduino. cc, get the Arduino IDE (1.6.4 or greater) Use version 1.6.2 or above only! If you already have an installed IDE, you may use it. If the proxy is causing you issues, you may simply try downloading the ready-to-go packages from the ESP8266-Arduino project. Put the ESP8266 Board Package in place. In the Arduino v1.6.4+ settings, paste the following URL into the Additional Board Manager URLs field: http://arduino.esp8266.com/stable/package esp8266com index.json [6].

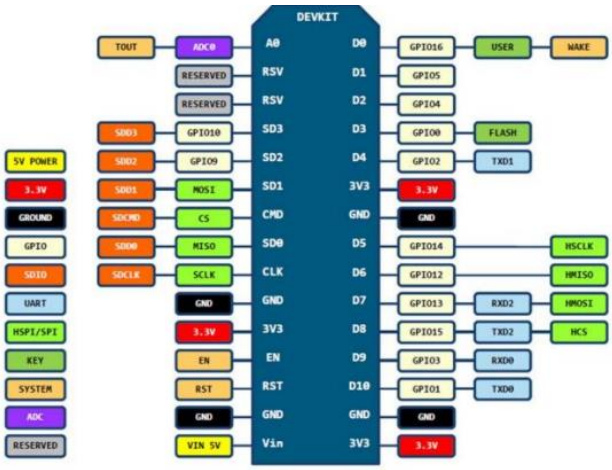

Figure 1: Represented the PIN Diagram for Tracking System [7]**.**

BLYNK

To be utilized with the Internet of Things, Blynk was established. It can store data, visualise it, showcase sensor data, connect operate hardware, and perform many other peculiar things. The platform consists of three main components:

Blynk App: This enables you to use the multiple widgets we provide to build spectacular interfaces with your businesses.

ISBN 978-81-962230-3-8 March 2023

Blynk Server: Accountable for coordinating all hardware-to-smartphone communication. You may host your Blynk server locally or just use our Blynk Cloud. It can even be established on a Raspberry Pi, is open source, and is effortlessly capable of overseeing thousands of servers.

Blynk Libraries: for all the popular hardware platforms - enable communication with the server and process all the incoming and outcoming commands [8].

Take a moment to imagine that each time you push a Button inside this Blynk app, a message is sent through the Blynk Cloud and then immediately arrives at your device. The process is the same as moving in the opposite direction, and it all occurs in a blink of an eye:

Features

i. All supported devices and equipment use the same API and graphical experience.

ii. Utilizing a connection to that same cloud

- WIFI
- Bluetooth and BLE
- Ethernet o USB (Serial)
- GSM

iii. A group of simple-to-use widgets.

iv. Pin manipulation is performed directly, without developing any code.

v. Using virtual pins, functionalities may be simply adapted and integrated.

vi. Super Chart widget-based analysis of historical data.

vii. Device-to-Device communication with the help of the Bridge Widget.

viii. Sending push messages, tweets, and emails.

ix. Constantly additional features are implemented.

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CHAPTER 9

USING THE REAL-TIME TRACKING SYSTEM IN INDIA

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In India, for instance, where there are 1.2 billion people in total, 9.9 million of them are laptop owners. It's challenging to comprehend how someone might survive in the modern world without a computer or a computer. They are now a common technological tool used mostly by people of all ages daily, and they have become crucial in essentially all modern contractual relationships. Every laptop serves as a storage device for significant data and information that seems to be highly valuable to its operator and whose loss or theft might generate substantial financial harm to that individual [1]. Astonishingly, the rate of survival for stolen computers in 2016 was just 7.8%, according to the National Crime Records Bureau. Police officers or indeed the crime section are accountable for dealing with such situations, although they are constantly preoccupied with more severe crimes. The task of finding the laptop is laborious and tiresome for the authorities. As a result, not every laptop is recorded. If the laptop belongs to an important person or if it holds valuable information for the country or domestic security, the crime department will use all reasonable diligence to find it. Thus, in the end, it is the average individual who is harmed.

Any guy might effortlessly monitor his or her laptop utilizing a GPS module, GSM module, accelerometers, and cloud services in the event of a burglary. IoT underpins every component of the system's operation. Even though there has been a lot of software engineering recently, it has not been very efficient. When laptop owner hears that their computer has been kidnapped, they can only help them search for it down, which can only be conducted when there is an operational internet connection. The user is reminded as soon as the laptop is moving via the real-time tracking and alarm system [2]. The owner will be immediately informed if the laptop makes even a sudden movement. Through a mobile application connected to their phone, the laptop's owner will be able constantly to maintain track of their laptop. Additionally, customers will have the option to activate another loud alarm in the laptop, which could make a criminal reconsider moving it with it [3]–[5].

Different Methods

The only security solution is that each finds a lost device and releases it to the owner, Absolute LoJack is the leading manufacturer in data protection and theft recovery. The proprietary Persistence technology, which is pre-installed in strategic instrument and, once enabled, can sustain a factory reset or hard wipe, enables the industry in terms of only the Investigations and Restoration Team to track down and recover a stolen laptop, smartphone, or tablet. However, this technology has the drawback that data gathering and tracking collection are only accessible while the laptop is online. Additionally, this technology won't be able to locate the laptop once it has been hijacked. Only after realizing that the laptop has been taken will the user become aware of the incident. There is a large number of different software available, but each has the same drawbacks [6].

Classifications of Hardware

ISBN 978-81-962230-3-8 March 2023

When the aforementioned equipment is used, the sensor stack and microcontroller are incorporated, and a steady relationship with the cloud server is maintained. A few obstacles, both material and financial, were presented while choosing the hardware. Given the total cost of the product, the hardware must have a low power need but a small physical footprint. A tiny capacity had to be chosen due to the device's configuration, which therefore gave us the limited capacity for power usage. We chose the STM32 microcontroller as mentioned in Figure 1, because it has dedicated sleep and deep relaxation modes, which would lower the power consumption total both while the device is operating and when it is sleeping.

Figure 1: Represented the diagram of the STM32 Microcontroller [7]**.**

In addition to collecting data from the sensors, analysing it, and sending it to the server via GPRS, the microcontroller (MCU) is also in charge of turning on the anti-theft alarm. If the owner believes there is a security danger to their device, a tiny alarm module will be implanted and activated. A GPS chip and a three-axis accelerometer are part of the sensor stack. We'll be utilising I2C via the SDA and SCL pins to communicate with the MCU. The Broadcom BCM4775X is the GPS chip in use. The SMD form of every chip utilized in the device allows for a lower footprint, and these chips also meet our predicted cost objectives. Flex PCBs will make it possible to utilize the same component in a variety of computers since they are less likely to sustain physical damage and can be wrapped and bent to fit around corners and edges.

Additionally, a micro USB connector will be included for quick firmware updates of the gadget. An FTDI RS232 USB to TTL converter will be connected in series with the USB interface for firmware reflating. In terms of communication, a SIM900 GSM chip will be used for GPRS connectivity. To transmit and receive data to and from the server, the AT command set will be utilized through a serial connection between the SIM900 chip and the STM32. Another factor to take into account is that separate baud rates need to be set up for various serial communications since interference will lead to device failure. The internal battery of the laptop will power the SIM900 chip due to the external battery's constraints. The 0.5 AH (ampere-hour) battery that powers the GPS chip and the MCU features built-in short circuit and excessive voltage protection. The internal USB ports with a rated output of 5V and a maximum current draw of 0.5A will be used to recharge the battery.

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ISBN 978-81-962230-3-8 March 2023

CHAPTER 10

CLASSIFICATION OF SOFTWARE

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The product's software features integrate the sensor stack, MCU, and smartphone application that relies on the cloud. The gadget attached to the laptop and or the smartphone application transmits information through a web server. As shown in Figure 1, the web server communicates with and receives data from the device using HTTP GET and POST requests. The server processes the information, which consists of latitude, longitude, and a few conditional bits, as required before sending it in JSON format after a few seconds to the application [1]–[3]. The software mostly on a smartphone app is going to be constructed in such a way that if the sensor longitude and latitude of the laptop are far beyond the user's range or if the laptop's placement is changed while the user is not comparable, the user will be instantaneously informed on the mobile application and will automatically trigger the alarm mostly on laptop forcing the thief to drop this same item and leave. If the end user considers that their laptop's security has been compromised in any capacity or that the laptop has been stolen, they will have the ability to remotely launch the anti-theft alarm. If the warning was accidentally activated, the consumer will also have the option of removing it. If the user's phone does not possess an active data connection, the device will send a Text message to the user's phone number including that of the geo-location coordinates. The user may then activate an audible alarm by sending a specified set of SMS codes to that same device.

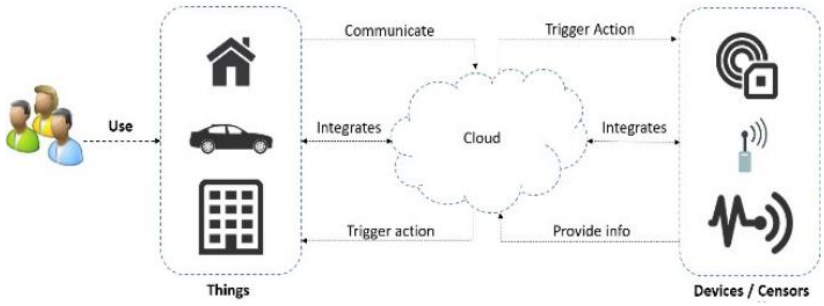

Figure 1: Represented the IoT Architecture.

Flowchart for Tracking System

For GPRS connectivity, a SIM900 GSM chip will be used, and to transmit and receive information to and from the server, the AT command set will be fully exploited through an usb communication between the SIM900 chip and the STM32. As a result, the mobile application of owner received a notice when an accelerometer is activated [4]–[8]. Now, the owner may enable the alarm module in the computer using the mobile application if he or she believes that the laptop is in danger. The alarm will emit a noise that will be heard up to 10 metres away. As a result, carrying the laptop while the alarm system is on would represent an extremely difficult and risky scenario for almost any burglar or thief. Now questions should surface as to what will happen if the laptop's owner unwittingly sets off the alarm while attempting to manage it. The owner of something like the laptop will thus be in charge of setting off the warning since

ISBN 978-81-962230-3-8 March 2023

they may remotely activate as well as deactivate it using a mobile application on their smartphone or tablet device. Through the GPS chip that is embedded into the laptop, the owner may also continuously track the movements or movements of his device (Figure 2).

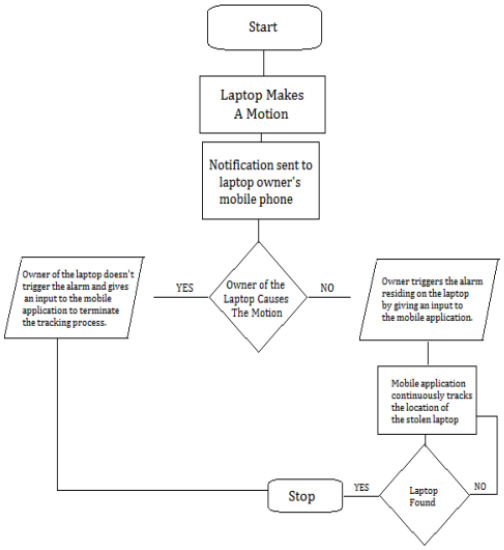

Figure 2: Illustrated the Flow chart for the tracking system.

The Broadcom BCM4775X is the GPS chip in use. The gadget connecting to the laptop and the android application exchange data through a web server. The web server employs software to transmit and receive data both to and from the gadget. The server processes this data, which consists of latitude, longitude, and a few Boolean bits, as required before sending it in JSON format every few seconds to the applications. The software on the smartphones app will be made in such a means that the user will be notified right away together with the location of the stolen laptop if the sensor parameters of the stolen laptop are beyond the customer's range or if the laptop's position is changing while it is not close toward the user (Figure 3).

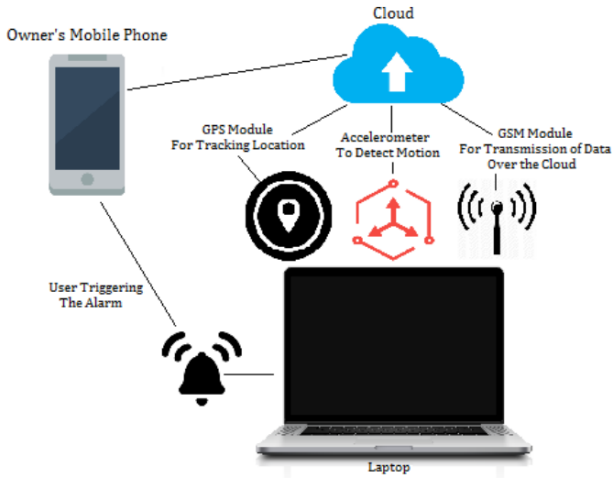

Figure 3: Represented the Basic Layout of the Tracking and Alert System.

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ISBN 978-81-962230-3-8 March 2023

CHAPTER 11

EMG sensor

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Since this information would be useful in developing the full prosthetic limb, the electrical circuit was created first to comprehend the size of either circuit. To manipulate the arm utilising muscles, a sensor was needed. The choice of motor was generally made based on size, simplicity of programming, and precision. Motors were needed to move the fingers. The microcontroller had to be chosen next, and the battery had to be chosen last. Sensor location and choice: An EMG sensor was used. It is a detector that detects electrical impulses produced by muscular action.

This encompasses both simple actions, such as moving a finger and considerably more difficult ones, such as grasping a fist and raising an arm. Because they may be applied without the necessity for surgery or the use of needles, surface EMG needles were chosen. The placement and orientation of the muscle sensor electrodes have a considerable influence on the signal intensity, making sensor positioning very important. The receptor is located in the centre of the muscular body and should line up with how the muscle fibres are oriented [1]–[3].

By putting the sensor in different places, the intensity and quality of the message from the device will be decreased. Entrance of raw EMG choosing the right kind and number of motors. The servo motor, which is often used in robotics because it is compact, powerful, readily programmed, and accurate, was chosen as the motor type and amount. A total of 14 servo motors were used, one because each finger joint, five for each finger, one for the thumb, and one for each of the other fingers (2 motors). As a result, the arm became lighter and more affordable.

Microcontroller choice: An Arduino development board was chosen since it is simple to buy, programme, and utilise an Arduino board. The microcontroller-equipped Arduino nano board was chosen because it is more compact, less expensive, and essentially identical to the Arduino microcontroller. Battery selection: A 2200 mAh, 11.1V battery was chosen based on specifications. Mechanical Design to make the mechanical design as realistic as feasible, group member Akshay Fulzele's precise hand measurements were acquired. The design has to allow for the arm to move and have room for the electronics while yet attempting to resemble a genuine arm. Because they are more easily customizable in the environment, 3D-printed items were chosen over mass-produced factory parts. Using factory-produced components may result in cost savings, but it is difficult to adapt and adjust the dimensions to suit each customer's needs.

Modelling in CAD:

For CAD modelling, a programme named Design Spark was used. The CAD files are very customizable to the individual's hand specifications.

ISBN 978-81-962230-3-8 March 2023

Due to their simplicity of customisation, 3D-printed items are favoured over mass-produced factory parts. It had a PLA component, a biodegradable polymer. This is an inexpensive, lightweight, ecologically friendly material that helps keep construction costs within reason. The material was printed using a Stratasys-made FDM 3D printer. Only 75 metres of material were needed for the components, and the print process took around 50 hours. This process is quick and effective for the general public. Mechanical the 3D-printed hand and fingers are part of the mechanical system, together with nylon paracord, fishing line, and servo motors. A fishing line is used to link servo horns to the motors and connect them to the fingers [4]–[6].

The servo horns are covered with an adhesive fishing line. Since of the strain in the fishing line, the fingers move however when the servo motors rotate. However, the 180-degree rotation drives were used instead of the 360-degree rotation controllers because they can only spin in one way and return in the other direction. The fingers shut when the thumb is closed, however, they may not return to their former positions when the hand is opened. The nylon paracord is useful in this situation.

It supports maintaining the original form and is robust.

Electronics the battery powers every component of the electronic system. The electrical activity generated by the muscles is extracted using the EMG sensor. The EMG sensor detects muscular contractions and sends a signal. This is sent to the Nano Arduino. An Arduino nano IO shield extension board was utilised to give the necessary space for all of the connections as the Arduino nano does not have enough room for them all. The nano categorises the output and functions as a microcontroller. It asks the servo motors to turn if the signal is higher than the present value, relaying the necessary information. It does not transmit a signal if the signal is below the preset value. With just 2 motors, fewer movements can be made, but it is still possible to make basic gripping actions.

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CHAPTER 12

AMPLIFIER AD8226

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An analogue signal is produced by user flexing and is amplified, rectified, and smoothed by the EMG sensor board. This analogue signal is converted into a pulse width frequency response by the microcontroller. In turn, this propels servo motors that tighten the tendons and because the fingers to curl. We must link the servo motors using a fishing wire to activate the 3D arm after executing the code on the Arduino Nano. As a microcontroller, the Arduino mini is very important. Results of the muscular flexing are seen [1]–[3].

AD8226:

The AD8226 is an instrumentation amplifier with a broad supply range that is inexpensive and just needs one external resistor to adjust any gain between 1 and 1000. A range of signal voltages may be used with the AD8226. The signal can use the supply rails to their maximum potential thanks to a broad input range and rail-to-rail output. Small signals close to the ground may be amplified without the need for two supplies since the complex workings also incorporate the capability to descend below the negative supply. For dual supplies, the AD8226 can work from 1.35 to 18 volts, and for a single supply, 2.2 to 36 volts. Real-world sensors are intended to be connected to reliable AD8226 inputs. The AD8226 can tolerate voltages over the rails in addition to having a broad working range. For instance, the component is warranted to tolerate 35 V at the input with no harm when powered by a 5 V source. To aid with open wire identification, minimum and maximum input bias currents are given.

Industrial applications requiring several channels but limited space are ideal for the AD8226. The AD8226 is a low-cost, low-power instrumentation amplifier that is capable of handling signals of up to 10 V and is designed with a nominal gain of 1. The MSOP packaging and 125°C temperature rating of the AD8226 make it ideal for designs with little to no airflow. The AD8226 is completely specified for operation from 40°C to +125°C and is offered in 8-lead MSOP and SOIC packages. Consider utilising the AD8227 if you want a device with a comparable package and performance to the AD8226 although with a gain that can be adjusted from 5 to 1000.

Materials for 3D printing

The method of creating three-dimensional (3D) objects via computer-controlled material joining or solidification is known as 3D printing. Rapid prototyping and additive manufacturing are both possible with 3D printing [4]–[7]. Using digital model data from a 3D model or a design and manufacturing file, objects of any form may be made (AMF).

Hideo Kodama of the Nagoya Municipal Industrial Research Institute created two additive methods in 1981 for assembling lobed plastic models with photo-hardening phenolic resin

ISBN 978-81-962230-3-8 March 2023

polymer, where the UV exposure area is dominated by a mask configuration or a scanning fibre transmitter. Additive manufacturing tools and materials were developed in the 1980s.

The majority of the design will be printed using PLA at a 1.75mm diameter. PLA was selected over ABS because of various variations between the two materials. ABS may also be utilised. Made from renewable materials like sugarcane or corn starch, PLA is a thermoplastic that may biodegrade (in the right circumstances). ABS, on the other hand, is not created from natural resources and is not biodegradable. PLA is more practical to use for 3D printing and is said to be safer than ABS. A crucial component of freedom of movement is relationships.

The hand section of the prosthesis is carefully designed since it is the location where the rope lines that will replace the servo motor and muscle fibres are gathered, along with connecting connectors for the palm, wrist, and arm parts. Polyethylene, a synthetic thermoplastic, is utilised to make the thread line. EMG sensors are a device that aids in connecting people and machines. To be employed in driver circuits' control operations, it transforms the tiny electrical impulses present in muscle neurons into analogue signals.

To make prosthetic hands and operate the hand during the prosthetic hand research, the EMG sensor was used. Analogue voltage output is how EMG sensors produce their output. As a result, both 3.3V and 5V systems may utilise it. The microcontroller used was an Arduino with an Atmel Atmega 328P. By gripping a range of everyday things, the expected Myoelectric Hand proved to be functionally successful. The prosthetic gadget was able to grab items like water bottles, wallets, disposable glasses, and PEPSI cans, among others. These activities needed very little to no help. The device's 3D-printed prototype, which was used to evaluate the viability of the suggested CAD design.96.7% accuracy was attained using SVM. It shows that the classifier is not making any errors while attempting to distinguish between signals originating from human muscles, leading to either decreased or no error.

With this level of precision, real-time surgeries are possible, and any patient may use the device. The main goal was to correctly move the fingers following the EMG-detected data. However, there were some issues with finger mobility owing to incorrect EMG signal categorization. The images below demonstrate how the myoelectric hand was able to grasp the things below without breaking them.

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CHAPTER 13

ARDUINO

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An open-source electrical platform or platform and the programming software are both referred to as Arduino. Artists, designers, amateurs, and anybody else interested in building interactive things or surroundings will find electronics easier to use thanks to Arduino. Because hardware design is platform-independent, an Arduino board may be bought already constructed or created by hand. Users may update and share their versions of the boards, as well as customize them to suit their requirements.

Various microprocessors and controllers are used in the designs of Arduino boards. The boards have a variety of expansion boards, breadboards (shields), and other circuits that may be interfaced with the sets of digital and analogue input/output (I/O) pins on the boards. The boards include serial communications interfaces, some of which support USB (Universal Serial Bus), which are also used to load software from personal computers. Typically, a dialect of elements from the programming languages C and C++ are used to programme microcontrollers [1]–[3].

The Arduino board began evolving as soon as it gained a larger audience, diversifying its offering from basic 8-bit boards to items for Internet of Things (IoT) applications, wearable technology, 3D printing, and embedded settings. All Arduino boards are fully open-source, enabling users to construct them on their own and ultimately customise them to suit their requirements. The programme is open-source as well, and people from all around the globe are contributing to its growth.

Benefits of Arduino

- Although it provides certain advantages over other solutions for instructors, students, and curious enthusiasts, Arduino also makes working with microcontrollers simpler.
- Affordable in comparison to other microcontroller platforms, Arduino boards are reasonably priced. Even the pre-assembled Arduino modules cost less than $50, and the cheapest Arduino module may be put together by hand.
- Cross-platform Arduino Software (IDE) is compatible with Linux, Macintosh OSX, and Windows. The majority of microcontroller systems are Windows-only.
- Easy-to-use, clear programming environment the Arduino Software (IDE) is versatile enough for sophisticated users to utilise while yet being simple enough for novices to use. It's built on the Processing terminal emulator, which is helpful for instructors since it means that students learning to programme in that environment will be acquainted with how the Arduino IDE operates [4]–[6].
- Open source and extendable software - Arduino software is made available as an open-source tool that seasoned programmers may modify. C++ libraries may be used to extend the language, and those interested in technical details can switch from Arduino to the AVR

ISBN 978-81-962230-3-8 March 2023

C programming language, on which it is based. Similarly to that, if you choose, you may directly include the AVR-C code in your Arduino applications.

Hardware that is open source and extendable - The Arduino boards' designs are made available under a Creative Commons licence, allowing qualified circuit designers to create their version of the module while modifying and expanding it. The breadboard version of the module may be constructed by even relatively unskilled users to comprehend its operation and save money.

Motor, Servo

Servo motors have many applications, from assisting walking robots to powering remote-controlled watercraft. Small servo motors are available for DIY projects, while bigger ones are available for industrial applications. A DC motor, a control circuit, and a potentiometer coupled to the output shaft are the essential components that make up a servo.

The servo-coded signals are sent via the output shaft, which may be positioned at a precise angular location. Small motors with built-in control circuitry may provide sufficient performance for their size. The potentiometer's resistance varies as the motor turns, allowing the control circuit to precisely determine how much movement is required and in which direction. The power that is provided to the motor is cut off when the shaft of the motor moves to the required position. Servo motors have proportional control, which means that they will spin more slowly when they are near the intended area and quickly when they are further away. Servo motors are very effective since they only work as hard as is required to finish the job.

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CHAPTER 14

POWER SOURCE

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This system must be transportable and run entirely on internal resources. For testing and debugging, using a wall supply of electricity is OK, but a prosthetic arm has to be supplied by a device an amputee would easily carry about. When in use, servo motors use a large quantity of electricity. Disposable batteries would not be a suitable option since the servos would use power too quickly, necessitating regular replacement. Rechargeable Lithium Polymer (LIPO) batteries have a high energy density.

Battery longevity and battery size might be compromised. The arm should ideally be able to function for several hours without requiring recharging. To do this, though, the battery's size can increase to a point where it cannot fit within the gadget. Cell Lithium Polymer Battery Powered EMG EMG Sensor Kit & Signal Output 3D Printed Myoelectric Prosthetic Arm the Servos and microcontroller need a lot of electricity, however, the muscle sensor kits need relatively little. For the muscle sensor kits to provide a positive and negative voltage reference, two power sources are needed.

Since these sensors are sensitive to input voltage spikes, a steady power source is necessary to provide signals of good quality. Due to these factors, two distinct 9V batteries are used to power the EMG-detecting boards. Power should last a good while on only two throwaway batteries. When they eventually wear out, they may be quickly and affordably replaced. A more advanced electrical system may use methods to provide a negative voltage for the EMG sensors to connect all parts to a single power source. By doing this, the present power supply system would be smaller, lighter, and less cluttered.

Linking Wires:

A wire is a single flexible strand or rod of metal that is typically cylindrical. Wires are used to carry electrical currents, telecommunications signals, and mechanical loads. When stated in terms of gauge number, wire gauges are available in a variety of common sizes. There are two types of wire: solid core and stranded. The outcomes of this program's work indicate that the day when we will have a fully working prosthetic hand is not far off. The user must move the Myoelectric Hand close to the item for it to begin opening or shutting in response to control instructions produced based on the EMG signal. The controller must categorise real-time signals to activate the motors. Given that the accuracy is more than 95%, it is very unlikely for the hand to act improperly. The hand will continue to be in the organised, preferred posture [1]–[3].

ISBN 978-81-962230-3-8 March 2023

Signals from the arm muscles were acquired using the EMG sensor, and the prosthetic arm was controlled to detect motions and manage the functioning of the prosthetic hand. The EMG sensor was used to collect the muscle signal signals. The microprocessor processed the signals that were received to produce meaningful values that were then sent to the servo motors to control the movement of the fingers. At the locations where fantastic test results and best results are decided, the muscle groups that will receive the signals will be taken for the carrier frequency are accepted. Numerous investigations have shown that different individuals will have varied values on the electrodes of circuit boards and EMG sensors.

It was done using a 3D-printed EMG sensor prosthetic hand to manipulate muscle signals. By translating analogue impulses from the forearm muscle obtained with electrodes to digital signals with a microprocessor, the servo motors are moved. The servo motor was changed to enable finger motions [4]–[6]. It has been shown that the physiological signals generated by the movements of the human arm's muscles and nerves can be transformed into electrical impulses, which can then be analysed and incorporated into electronic circuits. People with impairments will thus be able to live more comfortably thanks to the advancement of technology.

The value of one EMG sensor was chosen independently of the value of any other EMG sensor. The result is a prosthetic arm that is not only lightweight (at 250 grammes), but also substantially less expensive on the present market. It also has a strong grasp force of 55N. The design of the prosthetic arm has been modified to make it readily adjustable for manufacture following the hand dimensions and requirements of the client. The construction of a far better prosthetic arm will proceed to the next stage, which is the use of machine learning. Future development will focus on improving the prosthetic arm's usability and enhancing the prosthetic arm's design. Increasing the prosthetic arm's level of freedom. Making the initiative accessible to the public so that it may help individuals by raising their standard of living. Neuromuscular illness diagnosis using EMG signals.

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ISBN 978-81-962230-3-8 March 2023

CHAPTER 15

ALTERING THE ROTATION

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It was essential to fully dismantle the gearbox and make the following adjustments to accomplish continuous spinning of the servo motor and remove the potentiometer, and the feedback signal is provided through a half shaft hole in the gear that is connected to a potentiometer shaft. This hole was fully round when it was boring. By preserving all of the original gearbox components, this modification disengages the gear from the potentiometer feedback shaft and with the removal of the wedge the red circle enables uninterrupted complete rotation depicts the gear as it originally shows the upgraded equipment. The potentiometer circuitry was removed since it did not offer continuous rotation feedback. The potentiometer itself was left in place because it is incorporated into the body of the gearbox assembly and several of the gears share its shaft [1]–[3].

Constant input on a rotation change

A rotary encoder has been used in place of the servo motor's original potentiometer to provide continuous feedback. The rotary encoder is an electromechanical device (a sort of position sensor) used in a variety of industries, including consumer electronics, robotics, and elevators. By monitoring the rotation of the motor shaft when coupled with motor drives, they may offer information on position and rotation speed. Rotary encodes come in a wide range of varieties, and they are categorized whether it be by signal generator or sensor technology. This project makes use of an incremental rotary encoder. A fundamental idea of how an incremental encoder produces pulses, the disc includes two distinct signal contact points A and B as well as equally spaced contact zones that are linked to a common pin C.

When the disc begins to rotate, the common pin C will periodically make contact with the A and B pins, producing two square waves. Any one of the two signal pins may be used to detect rotation simply by counting the pulses on the pin. Both signal pins must be taken into account simultaneously for direction detection shows that the output signal on pins A and B is out of phase.

When the signal moves from high to low or from low to high, for instance, if steps are numbered each time, the received signal has opposing values, and we say the direction is clockwise. In the opposite case, the transmission will have the same value if the encoder rotates in the other direction. This makes it simple to programme the MCU to identify the direction and speed of rotation. The rotary encoder was used for this project. The size of the palm was a deciding factor in the encoder selection. The bigger encoder wouldn't fit in the palm's current model. This encoder has dimensions of 10 mm in length, 10 mm in width, and 2.2 mm in height. The

ISBN 978-81-962230-3-8 March 2023

output signals from a rotary encoder, R1-B and R1-A, are sent into an MCU's digital pins, which provide High and Low signal levels.

The rotary encoder is situated in front of the motor, which is housed in a palm, rather than being physically present on the PCB. Wires linked to the J8 connection connect the rotary encoder to the circuit on the PCB [4]–[6].

Replaced with a servo arm

The Servo motor's attachable arm is located on the gearbox's output shaft. A servo motor may be equipped with a variety of attachments by using this arm. The arm's swing in this instance, however, has a wide radius and is not suited for compact design. In addition, the arc is not long enough to fully seal the fingers of a prosthetic hand. The change was performed by removing the servo arm and manufacturing a pulley in three dimensions. Additionally, a pulley will be wrapped with an actuator string to enable even tighter finger closure showing the modified servo motor with a new pulley and the potentiometer removed. A subsequently removed servo driver integrated circuit board is still clearly visible.

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PUBLISHER

M/s CIIR Books & Publications
B-17, SECTOR-6, NOIDA,
UTTAR PRADESH, INDIA,
201301
Email: info@ciir.in

MARCH 2023
ISBN 978-81-962230-3-8

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