IOT – ENABLED SEA WEATHER AND POLLUTION MONITORING STATION

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Abstract

Unlike weather on land, sea weather is highly unpredictable and changes drastically at times. Keeping track of sea weather always is a very tough task. Also, sea pollution is a growing issue of concern and the first step to controlling pollution is measuring it. Another problem is the unavailability of cellular or other data networks in sea or data transmission. It is necessary to always use small sea weather stations with own data transmission capability in the sea to get data about these details. So, we hereby design and develop a small sea weather as well as sea pollution monitoring station that can transmit this data over to the monitoring station on sea shores. The system uses a range of sensors all controlled controlled by an Arduino UNO in order to achieve this task. Along with it we also develop a receiver system to receive and display the data from the transmitter. The transmitter unit is always in the sea and its not possible to constantly charge itself from time to time, so we use a solar panel to allow it to generate its own power and keep working in the sea. The transmitter uses turbidity sensor to check pollution, DHT 11 for Temperature and Humidity levels above the Sea water. Also, the system has an accelerometer sensor to detect sea state, depending on weather the sea is rough or calm, the accelerometer throws values that can be used to check if sea is calm or rough. These values are constantly monitored by the Arduino UNO and transmitted at certain intervals by through a n RF transmitter. The transmitter is fitted with a high gain antenna in order to achieve maximum transmission range. Now the receiver unit is developed using a Node MCU and display in order to receive data transmitted by the transmitter buoy and display it. The receiver unit consists of a n RF receiver with an antenna that is used to receive the data values transmitted by sea unit. This data is now received and processed by the Node MCU. The Node MCU now displays these values on the lcd display. If a value is not normal or beyond set range it also sounds a buzzer alert and displays alert in order to notify station officers to act and warn ships/people in the vicinity.

Introduction

Engineers from Multi remotes are here with a range of tested projects on Embedded Systems In the 21st century, there were lots of inventions, but at the same time there were pollutions, global warming and so on are being formed. So it's too important to find the solution for sea weather monitoring system. IoT is a solution. In recent days, developments in computing and electronics technologies have triggered Internet of Things technology. Internet of Things can be described as the network of electronics devices communicating among them by the help of a controller. The IoT is a collection of devices that work together in order to serve human tasks in an efficient manner. It combines computational power to send data about the environments.

These devices can be in form of sensors, appliances, embedded systems, and data analysis microchips. This project presents a low cost fire monitoring system, which is a solution for extinguishing the fire instantaneously. Microcontrollers and sensors are used for that system.IOT has proven extremely efficient in its ability to churn out piles of data, where it stands to improve and which will be an area of focus in recent times, is in its analytic capabilities. The Internet of Things, or IoT, has changed the frequency with which we interact with machines. Last year, there were an estimated 6 billion IoT devices in use, and it is not only consumers using them.

Everyone, from organizations to governments is looking at IoT to streamline processes and improve productivity in newer ways. The utility industry is going through a unique process of innovation and evolution. Renewables, IoT, and Electric Vehicles, among others, are dramatically changing the way we manage and interact with energy. This revolution comes along with new products and services, competition from outsiders, significant regulatory changes, and a savvier and more demanding consumer. These are challenging the Utilities had never faced in more than a hundred years. Wearable technologies, including smartphones are compatible with a plethora of software like heart rate monitors, cameras and touch/pressure sensors. The Internet of Things can be defined as devices that communicate with each other
over the Internet. The Internet of Things is a cutting edge innovation that allows all sensor data to be stored in the cloud and easily accessed from the cloud. The IOT also features sensors and actuators for collecting and transmitting data over the Internet. The cloud is used not only for storing data, but also for analyzing, collecting and visualizing data.

A weather monitoring station is a set of weather measuring instruments operated by a private individual, club, association, or even business (where obtaining and distributing weather data is not a part of the entity's business operation). The quality and number of instruments can vary widely and placement of the instruments, so important to obtaining accurate, meaningful, and comparable data, can also be very variable.
Weather stations may be operated solely for the enjoyment and education of the owner, but many personal weather station operators also share their data with others, either by manually compiling data and distributing it or through use of the internet or armateur radio.

The Citizen weather Observer Program (CWOP) is one such, and the data submitted through use of software, a personal computer, and internet connections (or amateur radio) are utilized by the National Weather Service when generating forecast models and by many other entities as well. Each weather station submitting data to CWOP will also have an individual Web page that depicts the data submitted by that station.
The Weather Underground Internet site is another popular destination for the submittal and sharing of data with others around the world. As with CWOP, each station submitting data to The Weather Underground has a unique Web page displaying their submitted data.

Literature Survey

IOT-Enabled Sea Weather and Pollution Monitoring Station ,project report was prepared by taking many research papers, presentations and also from some websites like IEEE website. Basic electronics by GROB. The sea weather and monitoring station project is a sustainable and innovative solution for continuous monitoring of

weather conditions and sea levels in coastal areas. Electronic Circuit guide book – Sensors by JOSEPH J.CARR.

Linear Integrated Circuits by D. Roy Choudhury, Shail Jain,Digital Electronics by JOSEPH J.CARR.Digital and Analog Communication System by K.sam Shanmugam.The concepts and Features of Micro-controllers by Raj Kamal.The 8051 Micro-controller Architecture, programming&Applications by Kenneth J. Ayala.Programming and Customizing the 8051 Micro-controller - by Myke Predko.

It is particularly important to be able to monitor the main hydrodynamic, oceanographic, and meteorological parameters of sea elevation within the entire Mar Minor region in response to both meteorological factors and circulation in the adjacent data Mediterranean Sea. The proposed model will use linear regression, which will predict the high and low temperatures as a linear combination of all the features. Linear regression does not use weather classification data of each day because this algorithm cannot be used with classification.

Therefore initially in our project only eight parameters are selected for use which are maximum temperature, minimum temperature, mean humidity, and mean atmospheric and The second algorithm to be used is a type of functional regress.

To that end we have designed, implemented, and validated the low-cost sensor buoy system described above. It is necessary to monitor the atmospheric pressure to compensate the sea depth measurement. coastal ecosystems, and mainly coastal lagoons which are among the most productive ecosystems of the planet and further play a major role in coastal fisheries as nursery and feeding grounds are particularly vulnerable to human factors causing the erosion of marine biodiversity centres where" the data are collected, analysed, and made into a variety of charts, maps, graphs and data sets.

Modern high-speed computers transfer the many thousands of observations onto surface and upper-air maps an area was dissected to anticipate the most extreme temperature of the following day at that area dependent on the day by day most extreme temperatures for a range of past n days alluded to as request of the info this context, there is an urgent need to gain an improved understanding of the ecology of species that are important for the functioning of coastal ecosystems, linked to hydrographic processes which explain t connectivity between populations.

With the increasing concern over environmental degradation and climate change, monitoring and managing sea weather conditions and pollution levels have become imperative.

Internet of Things (IoT) technology offers a promising solution by providing real-time data collection, analysis, and remote monitoring capabilities. This literature survey explores existing research and developments in IoT-enabled sea weather and pollution monitoring stations.

It examines various sensors, communication protocols, data analytics techniques, and applications utilized in these systems. Additionally, it identifies challenges, opportunities, and future directions in this field. IOT technology in environmental monitoring.Design and implementation of sea weather monitoring systems.Integration of pollution sensors into IoT networks.Data collection, transmission, and analysis methods.Case studies or field experiments involving sea weather and pollution monitoring.Challenges and solutions in deploying IoT systems in marine environments.Sustainability and reliability considerations for long-term monitoring.

By reviewing existing literature, you can gain insights into current trends, technologies, methodologies, and gaps in research, which can inform the design and implementation of your own IoT-enabled sea weather and pollution monitoring station. Types of sensors used for monitoring weather parameters (temperature, humidity,Rain,High Tides ,Gases.)IoT-based weather monitoring systems in marine environments.Data transmission and visualization techniques.Pollution Monitoring Sensors for detecting various pollutants (oil spills, chemical contaminants, plastics, etc.).IoT-based pollution monitoring platform Case studies of pollution monitoring projects in marine ecosystems.

Block Diagram of ATMEGA328/P Controller

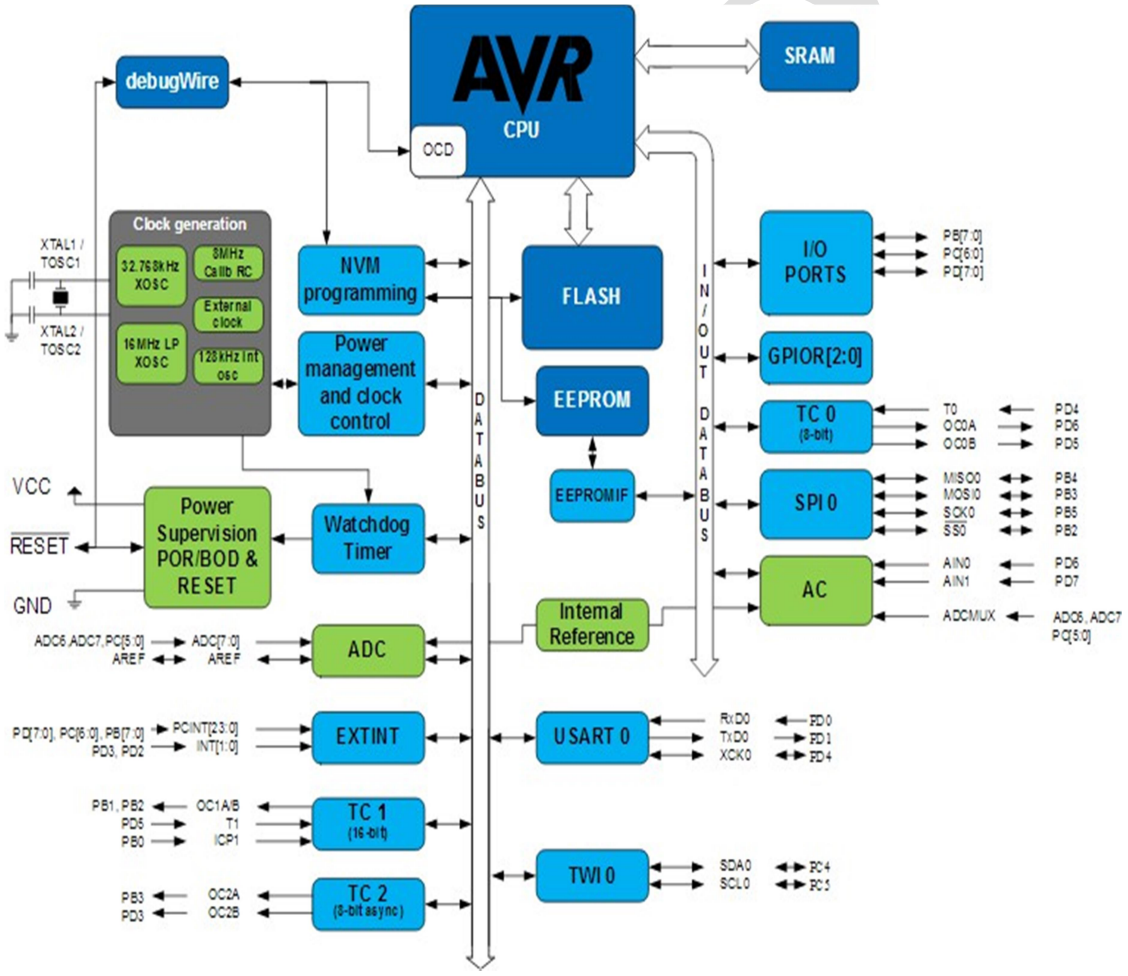


Fig.3.2: Block Diagram of ATmega328/P Controller

The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC to minimize switching noise during ADC conversions.

Pin Diagram of ATmega368/P controller

Fig.3.3: Pin Diagram of ATmega328/P

Atmel offers the QTouch library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully debounced reporting of touch keys and includes Adjacent Key Suppression (AKS) technology for unambiguous detection of key events. The easy-to-use QTouch Suite toolchain allows you to explore, develop and debug your own touch applications.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core.

Operation of ThingSpeak

In addition to storing and retrieving numeric and alphanumeric data, the ThingSpeak API allows for numeric data processing such as timescaling, averaging, median, summing, and rounding. Each ThingSpeak Channel supports data entries of up to 8 data fields, latitude, longitude, elevation, and status. The channel feeds support

JSON, XML, and CSV formats for integration into applications.

The ThingSpeak application also features time zone management, read/write API key management and JavaScript-based charts from Highslide Software / Torstein Hønsi. ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak.

With the ability to execute MATLAB code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics. Internet of Things (IoT) describes an emerging trend where a large number of embedded devices (things) are connected to the Internet.

These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights.

Cheap cloud computing power and increased device connectivity is enabling this trend. IoT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation. At a high level, many IoT systems can be described using the diagram below:

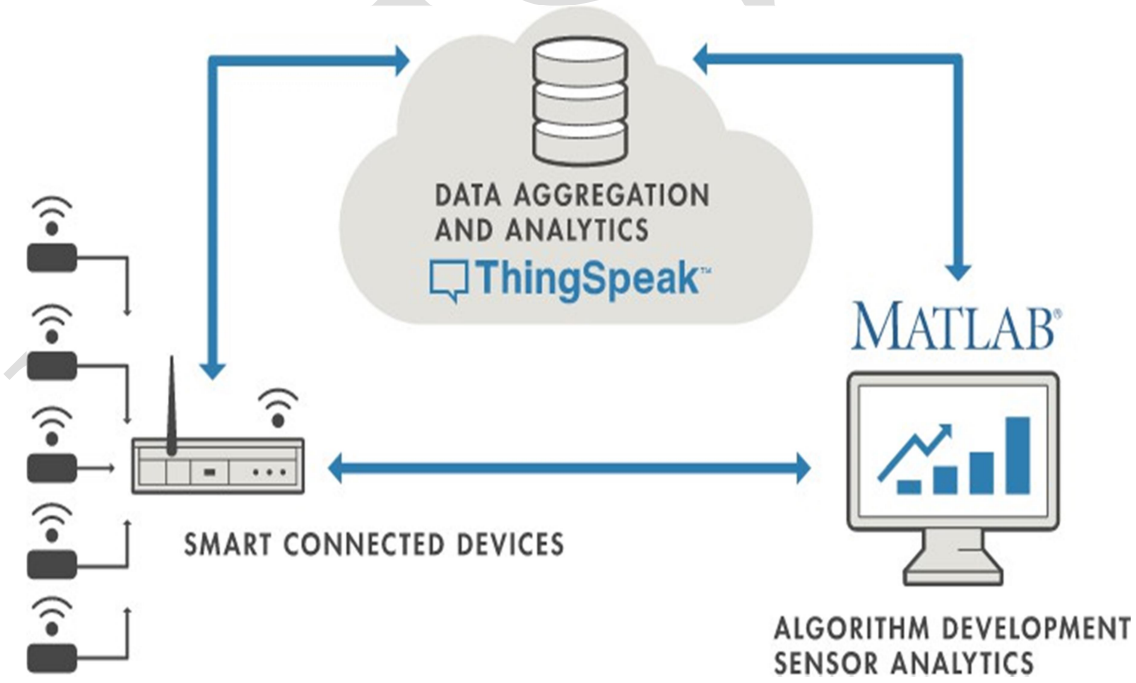


Fig 5.1 Thingspeak operation

On the left, we have the smart devices (the “things” in IoT) that live at the edge of the network. These devices collect data and include things like wearable devices, wireless temperatures sensors, heart rate monitors,

and hydraulic pressure sensors, and machines on the factory floor.

Results

Thing Speak is an open-source IoT platform that collects, stores, analyzes, and visualizes device data. IoT developers and hobbyists may build apps and projects without significant code or infrastructure setup using its simple interface. This system's major goal is to better anticipate weather from the sea. This model continuously records parameters and alerts to sense sea data. For instance, a flood is coming. Accelerometer buoys measure ocean-specific wave heights. The accelerometer buoy's main circuit includes a three-axis accelerometer, gyroscope, strong magnetic field meter, and electromagnetic compass module. Inertial navigation uses the four-element approach for coordinate conversion and the low-pass filtering algorithm for signal processing.

Quadratic integration of the signal yields the axial value. Wave height is calculated using Z-direction displacement. The buoy's inclination angle and the horizontal plane at the upper zero point are determined using the inclination measurement concept, and the wave direction technique is corrected using the electronic compass.

The wave height measurement instrument measures repeated waves. This data analyzes the immediate sea condition and compares it to the preceding occurrence. The present analysis report may forecast storms or deadly developments and give alarms. Since it transmits data from beyond the beach, this technology provides more relevant data.

The system design is more versatile than the current one. It has improved marine data measurement and analysis architecture. This contains an integrated power source for efficient work. This technology is automated and requires no human involvement, unlike others in this field. Despite having additional data measurement components, this system is cost-effective and uses less electricity. The system is more stiff to withstand severe weather and more water-resistant since it is further from the beach. The system may be scaled by adding components. Efficiency is important for every system. Data measurement and processing are efficient using this technology.

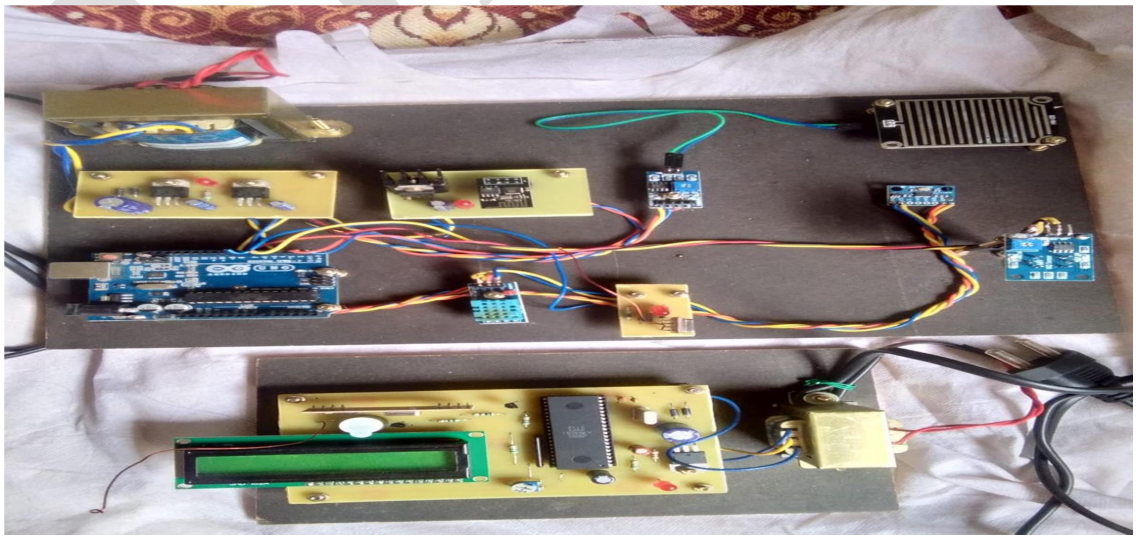


Fig 6.1 The physical connection of weather monitoring system

Thing Speak is hosted in the cloud, which means that the data collected from connected devices is stored and processed on remote servers, allowing for scalability, accessibility, and ease of use.

Phase 2 Results :

Phase 2 outputs are classified below by their respective values and graphs of High Tides, Harmful Gases near the sea .The inputs are from Transmitter Station which will update information for every 30 seconds to update into cloud.

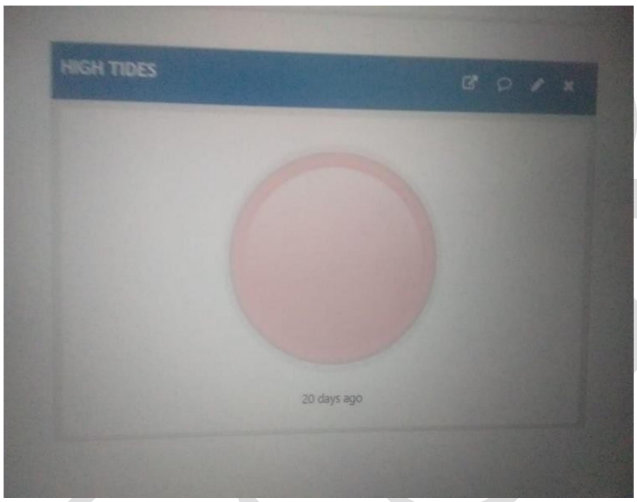


Fig 6.10 Low Tides indication in sea

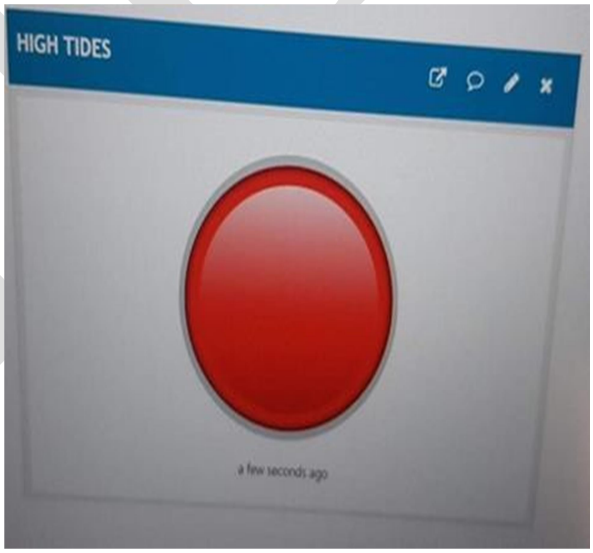


Fig 6.11 High Tides in sea

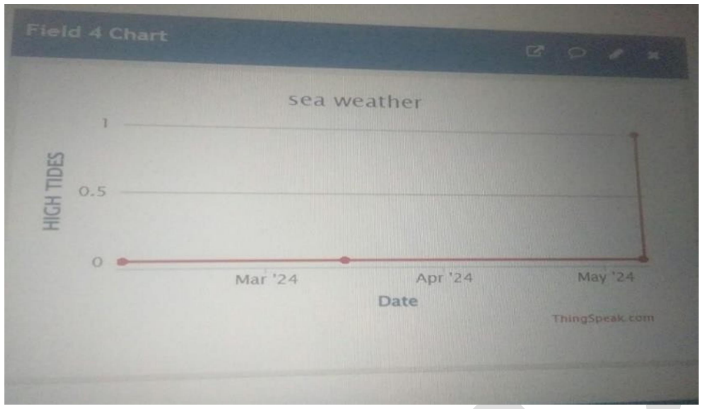


Fig 6.12 High Tides indication by values in graph

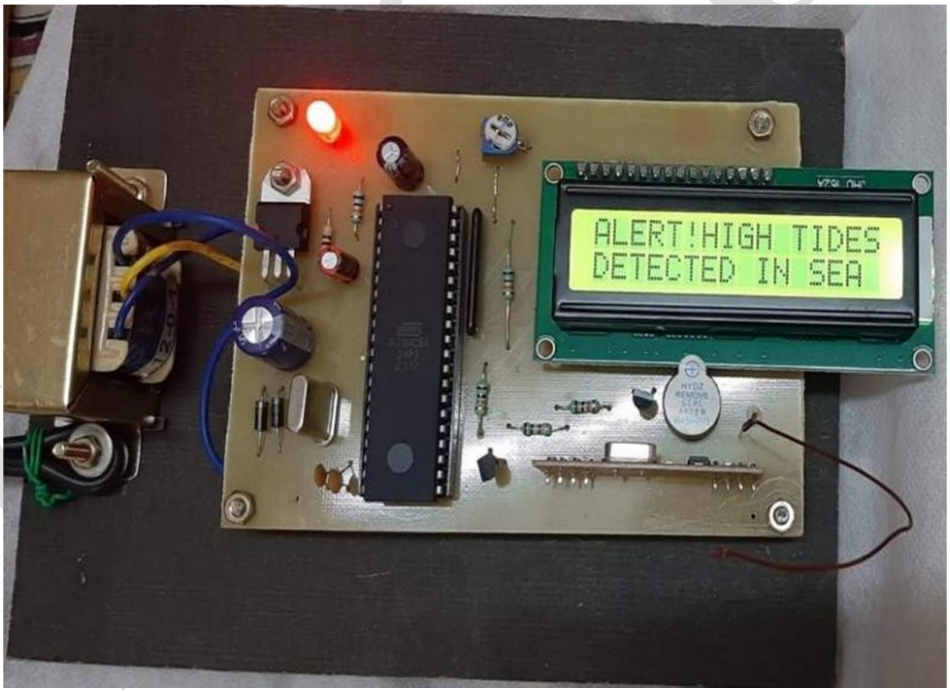


Fig 6.13 High tides detected in sea

The above image talks about the high tides which occurs in the sea above readings are Uploaded from the Receiver station (NodeMCU) to the cls with dark If the tides are low it is considered as 0 else it is considered as 1,then it glow dark with red colour.

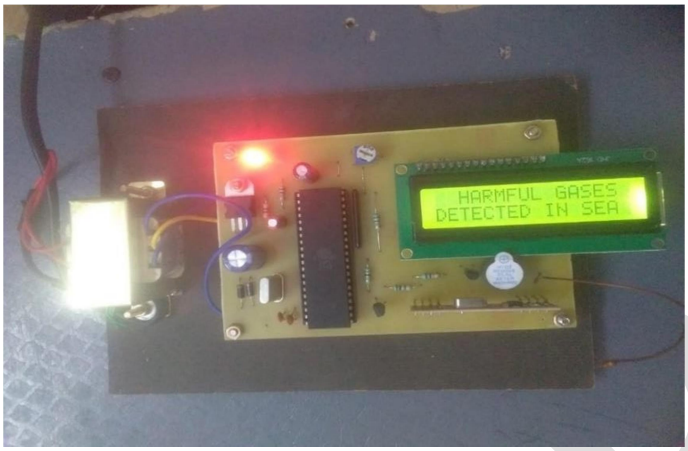


Fig 6.14 Detecting gases in sea

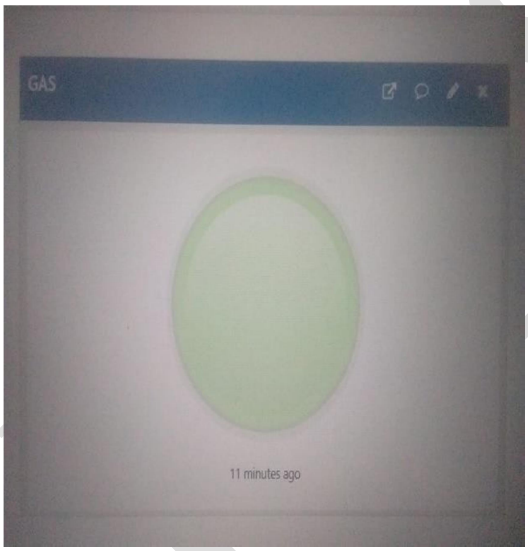


Fig 6.15 No Gases indication near sea

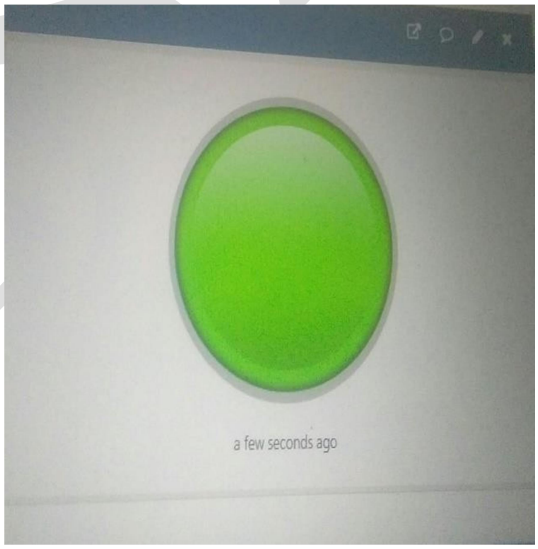


Fig 6.16 Harmful gases indication near sea

Gas Sensor (MQ3) module is useful for gas leakage detection (in home and industry). It is suitable for detecting Alcohol, Benzine, CH4, Hexane, LPG, CO. Due to its high and fast response time, measurements can be taken as soon as possible and sends this data to the Arduino.

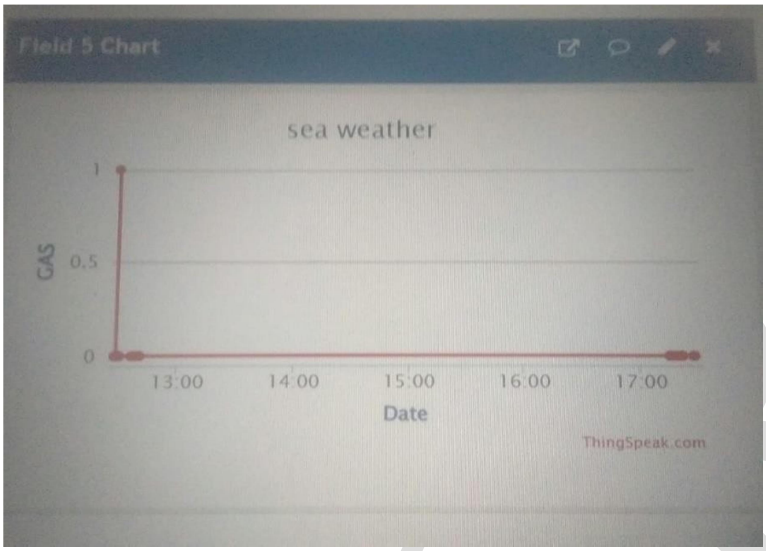
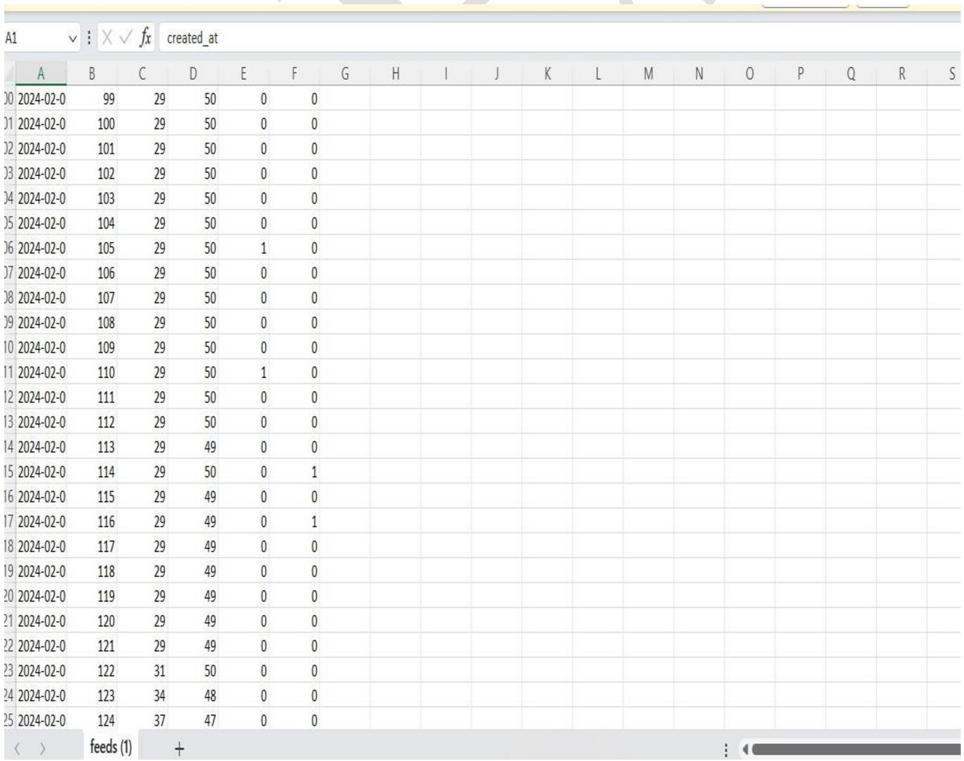


Fig 6.17 Harmful Gases indication by values in graph

The above image talks about the Harmful gases which occurs in the sea or near sea above readings are Uploaded from the Receiver station (NodeMCU) to the cls with dark If the gases are not appears it is considered as 0 else as 1,then it glow dark with green colour.

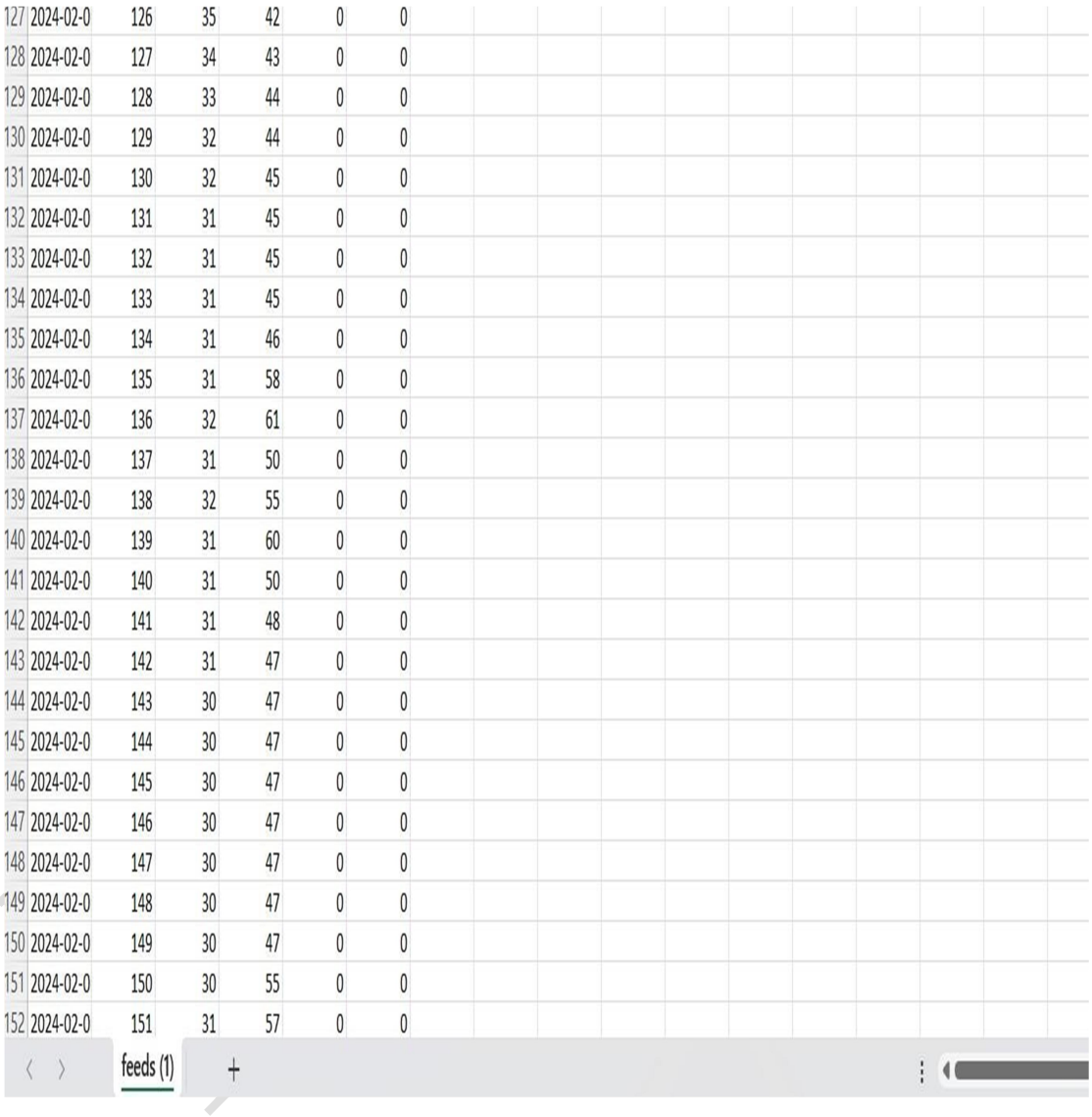


A1 | created_at

	A	B	C	D	E	F
0	2024-02-0	99	29	50	0	0
1	2024-02-0	100	29	50	0	0
2	2024-02-0	101	29	50	0	0
3	2024-02-0	102	29	50	0	0
4	2024-02-0	103	29	50	0	0
5	2024-02-0	104	29	50	0	0
6	2024-02-0	105	29	50	1	0
7	2024-02-0	106	29	50	0	0
8	2024-02-0	107	29	50	0	0
9	2024-02-0	108	29	50	0	0
10	2024-02-0	109	29	50	0	0
11	2024-02-0	110	29	50	1	0
12	2024-02-0	111	29	50	0	0
13	2024-02-0	112	29	50	0	0
14	2024-02-0	113	29	49	0	0
15	2024-02-0	114	29	50	0	1
16	2024-02-0	115	29	49	0	0
17	2024-02-0	116	29	49	0	1
18	2024-02-0	117	29	49	0	0
19	2024-02-0	118	29	49	0	0
20	2024-02-0	119	29	49	0	0
21	2024-02-0	120	29	49	0	0
22	2024-02-0	121	29	49	0	0
23	2024-02-0	122	31	50	0	0
24	2024-02-0	123	34	48	0	0
25	2024-02-0	124	37	47	0	0

feeds (1)

Before updating the information in the cloud it will be in the range 56. For every 30 seconds passes the information through wifi module and updates the particular values to cloud again after updating it slowly comes to the constant values.



127	2024-02-0	126	35	42	0	0
128	2024-02-0	127	34	43	0	0
129	2024-02-0	128	33	44	0	0
130	2024-02-0	129	32	44	0	0
131	2024-02-0	130	32	45	0	0
132	2024-02-0	131	31	45	0	0
133	2024-02-0	132	31	45	0	0
134	2024-02-0	133	31	45	0	0
135	2024-02-0	134	31	46	0	0
136	2024-02-0	135	31	58	0	0
137	2024-02-0	136	32	61	0	0
138	2024-02-0	137	31	50	0	0
139	2024-02-0	138	32	55	0	0
140	2024-02-0	139	31	60	0	0
141	2024-02-0	140	31	50	0	0
142	2024-02-0	141	31	48	0	0
143	2024-02-0	142	31	47	0	0
144	2024-02-0	143	30	47	0	0
145	2024-02-0	144	30	47	0	0
146	2024-02-0	145	30	47	0	0
147	2024-02-0	146	30	47	0	0
148	2024-02-0	147	30	47	0	0
149	2024-02-0	148	30	47	0	0
150	2024-02-0	149	30	47	0	0
151	2024-02-0	150	30	55	0	0
152	2024-02-0	151	31	57	0	0

feeds (1)

Fig 6.18 Updated values for every 30 seconds

The updates of the weather for every 30 seconds by changing the values from low to high for rain and high tides the value will be 0 or 1 for the dark colour will glow for both if value is 1 is 1 it will gives its raining or else not raining by indicating with 0.

Same for high tides if the value is 1 it may display high tide or else 0 means no high tides in the sea. For temperature,humidity ,Gases it will display the values from cloud the data is stored in the excel sheet by changing the values for every 30 seconds

Conclusion

It is equipped with various sensors, and provides real- time data transmission for accurate results.
Overall, it represents a significant step forward in the development of sustainable, data-driven solutions for coastal monitoring and management.

The future scope of solar sea weather monitoring stations is vast, as technology continues to advance and the need for accurate environmental data grows.
The major and critical task is preparing the software programming, performance of the module is purely depends on the software. The technology utilized for developing the prototype module only, it has to be enhanced to develop a real working system. Another advantage of using this tiny device is that it can perform the function of control action in addition to the efficient monitoring.
The sea weather and monitoring station project is a sustainable and innovative solution for continuous monitoring of weather conditions and sea levels in coastal areas. It operates autonomously using solar energy, is equipped with various sensors, and provides real- time data transmission for accurate weather forecasts and early warning systems.
The project is scalable , customizable, and has the potential to significantly improve our understanding of the impacts of climate change on coastal environments. Overall ,it represents

a significant step forward in the development of sustainable, data-driven solutions for coastal monitoring and management. The future scope of solar sea weather monitoring stations is vast, as technology continues to advance and the need for accurate environmental data grows. The main purpose of this project is to measure and display the weather parameters of the sea as well as transmit the same to the monitoring station and cloud memory by the microcontroller. As the controller cannot read the analog values, an ADC is required for converting analog information into digital, there by this arduino controller is selected that is having in-built ADC which is playing major role in this project work.

References

[1] J. Shivang, S. S. Sridhar, "Weather prediction for Indian location using Machine learning," International Journal of Pure and Applied Mathematics, vol. 118, no. 22 pp. 1945-1949, 2018.

[2] Z. U. Khan and M. Hayat, "Hourly based climate prediction using data mining techniques by comprising entity demean algorithm" Middle-East Journal of Scientific Research 21, vol. 8, pp. 12951300, 2014.

[3] S. S. Bhatkande1, R. G. Hubballi2, "Weather Prediction Based on Decision Tree Algorithm Using Data Mining Techniques." Belgaum India: International Journal of Advanced Research in Computer and Communication Engineering, vol. 5, no.5, pp. 483- 48, 2016.

[4] Y. Radhika, and M. Shashi, "Atmospheric temperature prediction using support vector machines." International Journal of Computer Theory and Engineering 1.1, vol. 1, no. 1, pp.1793-8201, 2009.

[5] S.S. Badhiye, B. V. Wakode, P. N. Chatur, "Analysis of Temperature and Humidity Data for Future Value Prediction" International Journal of Computer Science and Information Technologies, vol. 3, no.1 pp.3012-3014, 2012.

[6] F. Olaiya, Adesesan Barnabas Adeyemo, "Application of Data Mining Techniques in Weather Prediction and

Climate Change Studies," IJCSNS International Journal of Computer Science and Network Security, vol.17, no.6, pp 22-25, 2017.

[7] S. Ochoa-Rodriguez, L. P. Wang, P.Willems, and C. On of, "A review of radarrain gauge data merging methods and their potential for urban hydrological applications," Water Resource. Res., vol. 5, no. 8, pp. 6356–6391, Aug. 2019.

[8] PiyushKapoor and Sarabjeet Singh Bedi " Weather Forecasting Using Sliding Window Algorithm", Kvantum Inc., Gurgaon 122001, India MJP Rohilkhand University, Bareilly 243006, India, 2013 [9] Huang, C., Yang, Y., & Li, S. (2017). Design of sea water monitoring system based on Internet of Things. Journal of Physics: Conference Series, 869(1), 012039.

[9] Liu, Y., Zhang, B., & Gao, X. (2017). A sea water pollution monitoring system based on Internet of Things. International Journal of u- and e- Service, Science and Technology, 10(1), 43-52.

Liu, Y., Zhang, B., & Gao, X. (2017). A sea water pollution monitoring system based on Internet of Things. International Journal of u- and e- Service, Science and Technology, 10(1), 43-52.

[10] Aman, S., Abdullah, M. F., Ahmed, I., Imran, M. A., & Abbasi, A. (2017). Internet of Things (IoT) based system for real-time water quality monitoring in Aquaculture. Computers, Materials & Continua, 53(1), 61-77.

[11] Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2018). Internet of Things (IoT): A vision, architectural elements, and future directions.

[12] Masot, R. M., González-Partida, J. T., Jiménez-Moreno, G., & Baca, G. (2020). Sea water quality monitoring system based on Internet of Things for the Gulf of Mexico. Ocean Engineering, 201, 107006.