

AN IOT BASED SMART WATER QUALITY MONITORING SYSTEM

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Abstract: The Internet of Things (IoT) is the community of physical devices, vehicles, domestic appliances, and different items embedded with electronics, software, sensors, actuators and connectivity which allows these matters to join and exchange data. The range of IoT units has improved 31% year-over-year to 8.4 billion in 2017 and it is estimated that there will be 30 billion units by way of 2020. Water air pollution is a major environmental hassle in India. The greatest source of water air pollution in India is untreated sewage. Other sources of pollution encompass agricultural runoff and unregulated smallscale enterprise that consequences in polluting, most of the rivers, lakes and floor water in India. In this paper, An IoT Based Smart Water Quality Monitoring System the usage of Cloud and Deep Learning is proposed to display the nice of the water in water-bodies. In traditional systems, the monitoring process involves the guide series of pattern water from various regions, observed via laboratory checking out and analysis. This process is ineffective, as this manner is hard and timeconsuming and it does no longer grant real-time results. The quality of water need to be monitored continuously, to ensure the secure provide of water from any water our bodies and water resources. Hence, the layout and improvement of a low-cost system for real-time monitoring of water fine the use of the Internet of Things (IoT) is essential. Monitoring water quality in water our bodies the use of Internet of Things (IoT) helps in combating environmental problems and enhancing the health and residing requirements of all dwelling things. The proposed system video display units the exceptional of water relentlessly with the help of IoT devices, such as, ARDUINO UNO. The in-built Wi-Fi module is connected in ARDUINO UNO which permits web connectivity transfers the measured statistics from sensors to the Cloud. The prototype is designed in such a way that it can screen the number of pollution in the water. Multiple sensors are used to measure quite a number of parameters to determine the quality of water from water bodies. The outcomes are saved in the Cloud, deep learning techniques are used to predict whether or not the water appropriate or not.

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I. INTRODUCTION

Wireless sensor networks are turning into popular among the lookup neighborhood for their low-cost design and easy structure factor. The state-of-the-art developments in wireless technological know-how enhance giant area statistics acquisition and reliability in opposed environmental conditions. Moreover, the lookup neighborhood focuses on the form factor and enlargement of the wi-fi node involving in remote manner monitoring and automation. Internet of Things (IoT) is the mixture of a bodily object, controller, sensor, actuators, and Internet. IoT performs vital role in Industry 4.0. Actuators and sensors are the devices that have interaction with real-world bodily objects and collect data from the environment. Actuators and sensors, process the electrical enter and radically change into tangible action. IoT devices accumulate a big quantity of data, that are valuable and beneficial which must be stored, geared up and processed. The fundamental structure of IoT is based totally on three layers: i). Physical Layer, ii). Network Layer, and iii). Application Layer. In the bodily layer, sensors measure the records from outdoor surroundings and turn into valuable data. After records collection, time-sensitive data need to be processed immediately.

Otherwise, the facts have to be deeply processed and analyzed to be saved in the Cloud to keep away from community clutter. In the community layer, the raw facts are amassed from more than a few sensors to be aggregated and transformed to digital streams for data processing. For records processing, Data Acquisition System (DAS) [21] is the most appropriate manner to sample the indicators from the real-world objects to convert the results into digital numeric values that can be manipulated with the computer. The working precept of data acquisition is to convert analog waves into digital values for information processing. Internet gateway receives the aggregated and digital records via Wi-Fi, WLANs, etc. The utility layer provides particular offerings to the user.

Subsequently, the information can be safely saved in the server or Cloud for analysis. When IoT is augmented with sensors and actuators, the technological know-how will become a general class of Cyber-Physical Systems (CPS), that also encompasses applied sciences such as clever grids, virtual power plants, clever homes, clever classrooms, intelligent transportation, smart hospital, clever traffic, and smart cities. IoT specifically exploits general protocols and networking technologies. However, some of the major enabling applied sciences and protocols used in IoT are RFID, NFC, low-energy Bluetooth, low-energy wireless, low-energy radio protocols, LTE-A, and WiFi-Direct. Also, the chemical reagents prices are typically excessive that leads to an expand in the take a look at cost. The researchers' center of attention on developing a real-time water monitoring machine to measure the solvent and pollution in the water and ensure real-time information acquisition to the database the use of the Internet of Things (IoT) for stay water first-rate analysis.

III LITERATURE SURVEY

Environmental air pollution is the major motive to measure and recognize the toxic, chemical and organic quality parameters of water. Most of the water our bodies are polluted by humans. Almost 71% of the Earth's floor is covered by water, and over 96% of water is saline in the oceans. Water looks to be one of the principal sources for all the forms of life, along with human beings, animals, plants, trees, birds, etc. on earth for survival. On Earth, solely 2.5% of water is determined to be clean water. Albeit, 0.3% of freshwater is existing in lakes, wells, rivers and dams. In a year, about 95% of the accessible freshwater are entering into drains from households [27]. Nearly, 4 gallons of water is getting wasted thru leakage in faucets and other domestic use. About 80% of water receives polluted because of industrial wastage which is dumped into lakes, rivers and buried beneath deep oceans barring any proper treatment. A lot of poisonous marketers and chemical substances are getting dissolved in freshwater as a consequence making it highly contaminated. The human beings in rural areas do not have awareness about these contaminations. Around 70% of groundwater is being utilized for agricultural functions in the world. It is predicted that water demand is going to rise by 50% in the future. While the usage of polluted water for agriculture, the land additionally is additionally polluted which causes serious damage for all the structured dwelling matters [6]. As the water our bodies pollute the land, it creates an imbalance in the surroundings biosphere. Any imbalance in the water will have an effect on its satisfactory that severely influences the ecological system amongst the species [5]. Most nuclear reactors' wastage are sealed and buried underneath the ocean; if any leakage happens, the complete sea will come to be unsafe and every dwelling component in the sea receives affected. During the 19th century, water samples had been gathered from a range of places and have been examined in the laboratory. The effects were astonishing [9]. A learn about by way of water resource estimated that 41% of human beings residing in city areas stay barring adequate sanitation. Nearly 80% percentage of disorder unfold through polluted water. Some of the ailments might not reflect immediately, it will have an effect on the internal organs of the living things and later purpose serious effects. In some countries, lot of human beings do no longer have get entry to to easy water due to lack of authorities prioritization, lack of committed funding, shortages in human resources and the exacerbating effects of local weather exchange on water availability and great [17]. There are about one hundred and one main parameters to check the water fine initiated by way of the environmental protection organization [24]. If any of the values crosses its parameter degree then it is an imbalance in water and it

isnot appropriate for home usage. To grant a achievable andcost-effective answer to this problem, sensors areconsidered. With the assist of sensors, a answer is offeredthat can drastically minimize the costs, as nicely as providethe competencies to display the water qualityuninterruptedly. There comes a lot of challenges tomonitor the fine of water owing to human disaster,population increase and surprising adjustments in theenvironment. IoT will become the generation of sensing theenvironment consistently in real-time and capable to provideaccurate results. The use of automation for continuousmonitoring reduces the guide strength and for that reason reducesthe price too. This mechanism is being designed anddeveloped with a low value superb monitoring machine forthe essential parameters in real-time. In the proposedwork, pH, Humidity, Temperature, Co2 sensors are usedto measure the great of water continuously. In additionto pleasant parameters, poisonous chemical substances are additionally beingmonitored with the useful resource of the MQ-9 sensor. Nowadays, itwas amended to display the water our bodies to proceed tohave exact fitness for all varieties of lifestyles in the world and tobalance the ecological machine in the biosphere. In thiswork, the sensors are related to the ARDUINO UNOmicrocontroller that it transmits the sensed statistics to thecloud. Furthermore, the saved records in the cloud can beretrieved and used for similarly evaluation the use of deep learningmechanisms.

III RELATED WORK

Fiona Regan et al. have mentioned a clever qualitymonitoring gadget in figuring out the records to be sentwirelessly. Fiona Regan et al. have proposed an concept ofachieving the goal by using amassing the statistics from all thenodes wirelessly. It discusses the series of waterquality parameter facts from clever sensors and sends thedata to the device. In this system, the gathered records aregiven to a far off server via the GPRS network. So,the consumer can view the information remotely. The sensors werepresent in water faucet to measure whether or not the parameters ofwater. Fiona Regan et al. have noted that this systembecomes especially scalable, quicker and user-friendly. Butsome problems have been observed in the current methodology thatsmart sensor turns into incredibly high priced and any of the nodesfail in the network, then the route of facts transmission willbe lost.Moreover, the measurement of the sensors is no longer dependable in thewater tap. ZulhaniRasin et al. [26] have described theimportance of a water best monitoring gadget withZigbee protocol based totally on Wireless Sensor Network. Inthis system, some sensors are linked to the ZigbeeZMN2405Hp module to measure the first-class of water. It isimplemented thru WSN proposing excessive powertransmission Zigbee based totally technological know-how and additionally with IEEE820.15.4 like minded transceiver. On the receiver side,Zigbee is linked to the Personal Computer that showsthe GUI of the circuit. The excessive energy Zigbee is used in this machine and it can be utilized for small place network.Data storage in the base station is necessary. ZulhaniRasin et al[26] have observed some problems in the existingmethodology in measuring the presence of gasoline presentinside the water and water bodies.NazleeniSamihaHaron et al. [15] have proposed an ideain creating a far flung water best monitoring systemusing wi-fi sensors for the removing of costconsuming jobs of guide monitoring. The proposedwork usually focuses on the aquaculture for prawnfarming. The measured values are accrued through the facts kitwhich sends the statistics to the processing unit thru GSMmodem. NazleeniSamihaHaron et al[15] have centered onmonitoring the pH, temperature and dissolved oxygen inwater. EZ430-RF2500 is the hardware module usedwhich, consists of two components one is the quit gadget andanother is an get admission to point. The statistics from exclusive sensorsare monitored in the information processing unit and continuouslycompared with the steady parameter values. With thehelp of GSM modem every time the sensor fee crossessthe threshold parameter value, then an alert message issent to the farmer. If the water does not meet its qualityparameter value, then, an alert sign is related to thebuzzer. In the proposed work,mobile cellphone is required fortesting functions and the telephone act as the client. Theproposed machine [15] is greater environment friendly in monitoring theprawn pond in aquaculture. NazleeniSamihaHaron et al[15] have determined that is no longer appropriate for long-distance andalso it work for solely single unit of the water source.Without cell phone, the farmer may not get hold of an alertmessage in case of the unavailability of phones. If

the phone receives damaged, then it would end up a major problem with this system. Dong He et al.[3] have mentioned the water quality monitoring gadget primarily based on Wireless Sensor Network (WSN). Dong He et al. have proposed an thinking to monitor the water exceptional primarily based on WSN the use of the wireless network and far off facts center. WSN collects the data about the nice of water from special areas and transfers the records to a far off statistics core with the assist of GPRS DTU, which is constructed upon the TCP/IP protocol used for facts transmission. In the proposed machine the WSN is built on Zigbee protocol, it is typically used for personal area networks and in a peer-to-peer community and so the transmission is very high. According to the function, the nodes of WSN are divided into three parts: coordinator, router, terminal. The duty of the coordinator is to receive and to switch the information to GPRS DTU. Router node typically has no impartial feature of collection, it will switch facts from the terminal node to the coordinator node. Finally, the terminal node has different sensor modules like pH module, Pollutant levels, temperature, turbidity and so it will acquire and transmit the data. With the assist of the records accumulated from the data center is analyzed and used for in addition processing. This system can be used for the lengthy time period due to the fact it is stable and real-time water best monitoring. However, this method isn't always a low-priced answer for a massive area. Kulkarni Amruta et al.[10] proposed an thought of developing a solar-powered water nice monitoring system primarily based on wi-fi sensor networks. In this system, Kulkarni Amruta et al broadly speaking targeted on quality parameters like pH, oxygen degree and turbidity through WSN science that has been powered the use of a solar panel. In the proposed work, the simulation work was done to analyze the nice parameters for first-rate control with VB and MATLAB to measure the graphical and numerical record. In this system, the nodes acquire the data from one of a kind wi-fi sensor and switch the statistics to the base station. With Zigbee protocol, the nodes can transfer the measured records to the base station that is powered by the photo voltaic panel. With the assist of the photo voltaic panel, the system always receives energy supply and will become more efficient. The machine is pricey as nicely as, if the solar panel can't be charged or acquired broken due to the fact of any environment threats then the gadget will cease working.

IV METHODOLOGY

In this system, we are the use of arduino as the microcontroller. The complete device is designed in embedded-C and simulating the written code the usage of Arduino IDE. For facts series on PH, water level, temperature and leakage of the surrounding atmosphere, the water first-rate monitoring machine employs sensors. These data's can be accessed by way of licensed customers by means of the use of a consumer ID and password on the internet server by means of logging into their accounts. The gathered data is saved and analyzed and transmitted in real-time. A rectifier, relay and a transformer are linked with the microcontroller. The ESP8266 is a low value wi-fi module consists of a full TCP/IP stack wi-fi chip and a microcontroller chip arduino, which facilitates the information storage in IOT cloud. The wi-fi module makes use of transmitter and receiver serial pins for sending and receiving data, for altering wi-fi module settings and for altering the serial question commands. The information from the sensors will be displayed on the LCD display. The code boots from exterior flash without delay at some stage in the processing of the program, thereby increasing the gadget overall performance and storage necessities due to their optimized cache capacity. Finally, we can get admission to the data on the internet utility the usage of non-public android phones.

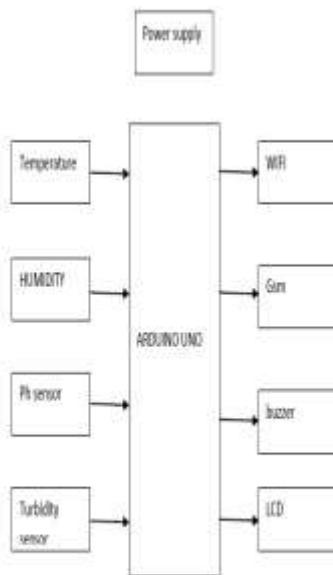


Fig1: Block diagram of Water monitoring

V. SOFTWARE AND HARDWARE

Arduino Mega 2560:

The Mega 2560 is a microcontroller board undertaking to the ATmega2560 (data sheet). It has fifty-four stepped ahead data/yield pins (of which 15 can be used as PWM yields), sixteen easy facts sources, 4 UARTs (gear consecutive ports), a sixteen MHz treasured stone oscillator, a USB affiliation, a electrical energy jack, an ICSP header, and a reset button. It consists of all that everyday to help the microcontroller; if fact be informed confederate it to a PC with a USB connection or electrical energy it with an AC-to-DC connector or battery to start. The Mega is feasible with most protects proposed for the Arduino Duemilanove or Decimal. The Mega2560 changes from all first sheets in that it would no longer use the F TDI USB-to-constant driver chip. Taking the entire element into account, it includes the ATmega16U2 (ATmega8U2 in the alteration 1 and change two sheets) redid as a USB-to-constant converter. Update two of the Mega2560 board has a resistor pulling the 8U2 HWB line to ground, simplifying it to put into DFU mode.

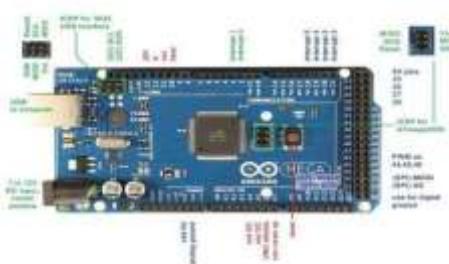
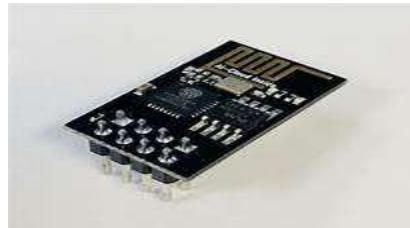


Fig2: Arduino Mega

ESP8266:



ESP8266 is a low-cost WiFi module that belongs to ESP's family which you can use it to manipulate your electronics duties someplace in the world. It has an in-built microcontroller and a 1MB flash enabling it to be a part of to a WiFi. The TCP/IP protocol stack lets in the module to speak with WiFi signals. The most working voltage of the module is 3.3v so you cant provide 5v as it will fry the module.

GSM:



Fig8:Gsm

GSM (Global System for Mobile correspondence) is a computerized versatile commercial enterprise company that is generally utilized by using the usage of phone cellular telephone smartphone clients in Europe and one of a kind components of the world. GSM makes use of a range of time division notable get acceptable of entry to (TDMA) and is the most appreciably utilized of the three computerized a approaches off dialog innovations: TDMA, GSM and code-division extraordinarily a range get perfect of entry to (CDMA). GSM digitizes and packs information, at that factor sends it down a channel with two one-of-a-kind surges of purchaser information, every and each and every time enabling opening. It works at every the 900 megahertz (MHz) or 1,800 MHz recurrence band.

LCD:

LCD stands to get Liquid Do rystal Display. LCD is discovering giant unfold utilization substituting LEDs (7 region LEDs or desire multipurpose section LEDs) as a Result of These motives: The diminishing charges of LCDs. The manageable to showcase characters, numbers and images. It will be in distinction to LEDs, that can be limited via portions plus a couple figures. Incorporation of the sterile manipulate in to the LCD, consequently relieving the CPU of this Endeavor of sterile the LCD. By comparison, the LED has to be delighted with the CPU to hold exhibiting the info. Benefits of programming to get snap shots and characters. All these factors have been "technical" due to the reality of used in mixture with the micro-controllers, that potential they may additionally moreover now no longer be prompted by way of capacity of ordinary IC circuits. They're Used for composing outstanding messages onto a tiny LCD.

TEMPERATURE:

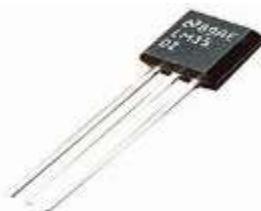


Fig8: LM35

LM35 is a temperature measuring machine having an analog output voltage proportional to the temperature. It affords output voltage in Centigrade (Celsius). It does now now not require any exterior calibration circuitry. The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage moreover increases.

HUMIDITY:

Humidity sensors are digital devices enabling you to measure the environment's humidity and convert the data into a corresponding electrical signal that can be used for brilliant purposes. You may additionally have heard a one of a type humidity sensor name: Hygrometers! They are moreover recognised as hygrometers alternatively "humidity sensor" is higher common. Humidity is genuinely the presence of water in the environment. It is imperative to measure the volume of water vapor in the air on account that it can have huge penalties on our lives as correct as distinctive manufacturing processes. So the subsequent time any one asks: "what is humidity sensor and why it matters?" you then understand how imperative they are in every and each element of our day to day existence due to the truth humidity has an have an impact on on chemical, biological, and bodily processes. Air humidity sensors measure this volume and convert it into a readable shape of data for exterior uses.

BUZZER:



Fig10: Buzzer

An audio signaling computing device like a beeper or buzzer may additionally moreover be electromechanical or piezoelectric or mechanical type. The most necessary attribute of this is to convert the sign from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the particularly a vary designs, it can generate one of a kind sounds like alarm, music, bell & siren. The pin configuration of the buzzer is proven below. It consists of two pins in precise extraordinarily exact and negative. The amazing terminal of this is represented with the '+' picture or a longer terminal. This terminal is powered with the useful resource of 6Volts whereas the horrific terminal is represented with the '-' symbol or fast terminal and it is related to the GND terminal.

PH SENSOR:



Fig10: Ph sensor

pH is an digital system which is used for measuring the pH stage in water. It consists of three sorts of probes (i) Glass electrode (ii) Reference electrode (iii) aggregate of gelectrode. pH is described as the bad logarithm of hydrogen ion awareness in water.

$$\text{pH} = -\log[\text{H}^+]$$

A pH meter consists of distinctive probes which are connected to an digital meter that would show the reading. If the pH degree is much less than 7 then it is acidic in nature, if the Ph level is increased than 7 then it is alkaline in nature, and generally the vary of pH is 0-14pH. Operating range: 0-14. Operating temperature: 0-45. Operating voltage: -5 to 5 v. Output voltage: analog.

WATER LEVEL SENSOR:



Fig10: Water Level

Water leakage sensor is designed for detecting water degree in reservoir and overhead tanks. This is broadly used in sensing the water leakage, water stage and the rainfall. It consists of mainly three parts: $1M\Omega$ resistor, an digital brick connector and quite a few strains of naked conducting wires. It works by way of having a sequence of uncovered traces which are connected to ground. This is additionally interlaced between grounded traces and the sunstrokes. A susceptible pull up resistor of $1M\Omega$ is present. $1M\Omega$ resistor pulls up the sensor value until a drop of water shorts the sensor hint to the grounded trace. This can measure the water droplet/water dimension by using a sequence of uncovered parallel wires. The characteristics are it has low strength consumption and excessive sensitivity.

TURBIDITY SENSOR:

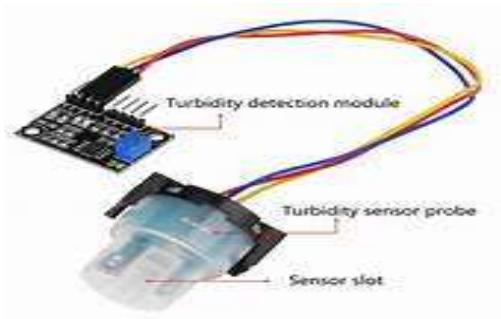
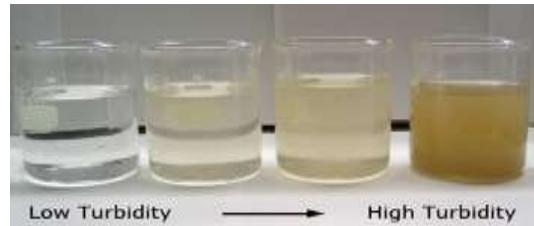


Fig10: Turbidity sensor

Turbidity is the cloudiness or haziness of a fluid prompted with the aid of giant numbers of man or woman particles that are usually invisible to the bare eye, comparable to smoke in the air. The dimension of turbidity is a key take a look at of water quality.



Turbidity is induced by means of particles suspended or dissolved in water that scatter light making the water show up cloudy or murky. Particulate depend can encompass sediment, specifically clay and silt, satisfactory natural and inorganic matter, soluble coloured natural compounds, algae, and different microscopic organisms.

Arduino IDE:

Arduino is an open-source PC tools and programming association. The Arduino Community is recommended to the activity and patron mastermind that constructions and occupations microcontroller-based motion sheets. These alternate sheets are recognized as Arduino Modules, which are open furnish prototyping stages. The smoothed out microcontroller board suggests up in an assortment of increase board packs. The transcendent drastically perceived programming method is to use the Arduino IDE, which organizations the C programming vernacular. This offers you get to an Arduino Library that is industriously making draw close to open furnish network.

VI. EXPERIMENTAL RESULTS

The hardware set up is made as per the above figure. When the cutting-edge grant is given to the set-up, the step-down transformer reduces to 12-15V and the bridge rectifier will convert AC to DC supply. This is related to the arduinomicro-controller. The values from the sensors particularly PH, temperature, water degree and water leakage sensors will be displayed on the LCD screen which is related to the micro-controller. The values are analysed, transmitted and stored in cloud the use of Wi-Fi module for actual time applications.



Fig -3. Water monitoring system



Fig -3. Home page



Fig -3. Sensor data

VII CONCLUSION

In this project, it explains about the elements of the mission and the use of the sensors and cloud storage approach and equipment used for the clever cities water exceptional monitoring device. The use of the IoT platform. We used PH, temperature, water stage and water leakage sensor for the measuring and understanding the quality of the existing water. The statistics values of the sensor are received and displayed on the LCD display screen. The future strategies and thoughts can be developed from this basis. It is achieved in conversation applied sciences and can be introduced as a software program interface for in addition uses. So that it helps human beings to raise their very own work at the identical time and can view the actual time facts values from any-where and at anytime the usage of the clever cell phones. It

price much less and is small in size. It can be used at somewhere even in industrial level. It checks water degree and nice of all specific tanks with different liquids. We can additionally use this in greater stage projects. The essential gain is that it offers enough furnish of water with excellent great for protected drinking. By implementing this approach of idea, there will be secure ingesting of water in future and the pleasant of the water is monitored and checked wherever we are.

FUTURE SCOPE

In the upcoming generation, this proposed device by embedding synthetic brain will be beneficial in making the system self sustaining with defining some kind of policies and regulations with excessive standards. This will convey use of automatic and clever distribution of water barring the use of human invention. The trouble springing up can be without difficulty sorted out with automated notification to the faraway handling device to the accessed user. It can be used in industrial purposes. In industry, we can use ultrasonic sensors in place of steel wires which offers greater correct information. It may additionally be used in the flood susceptible areas and in dams for the humans to be secure with the aid of understanding the water stage best and it can be knowledgeable through a notification. Therefore, if the degree of water is above the saturated level, it will ship notification upon the app so that we can alert the people. From this, many verbal exchange applied sciences can be delivered based on our want of requirements.

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