Water management system using IOT

Phase 5: final peoject

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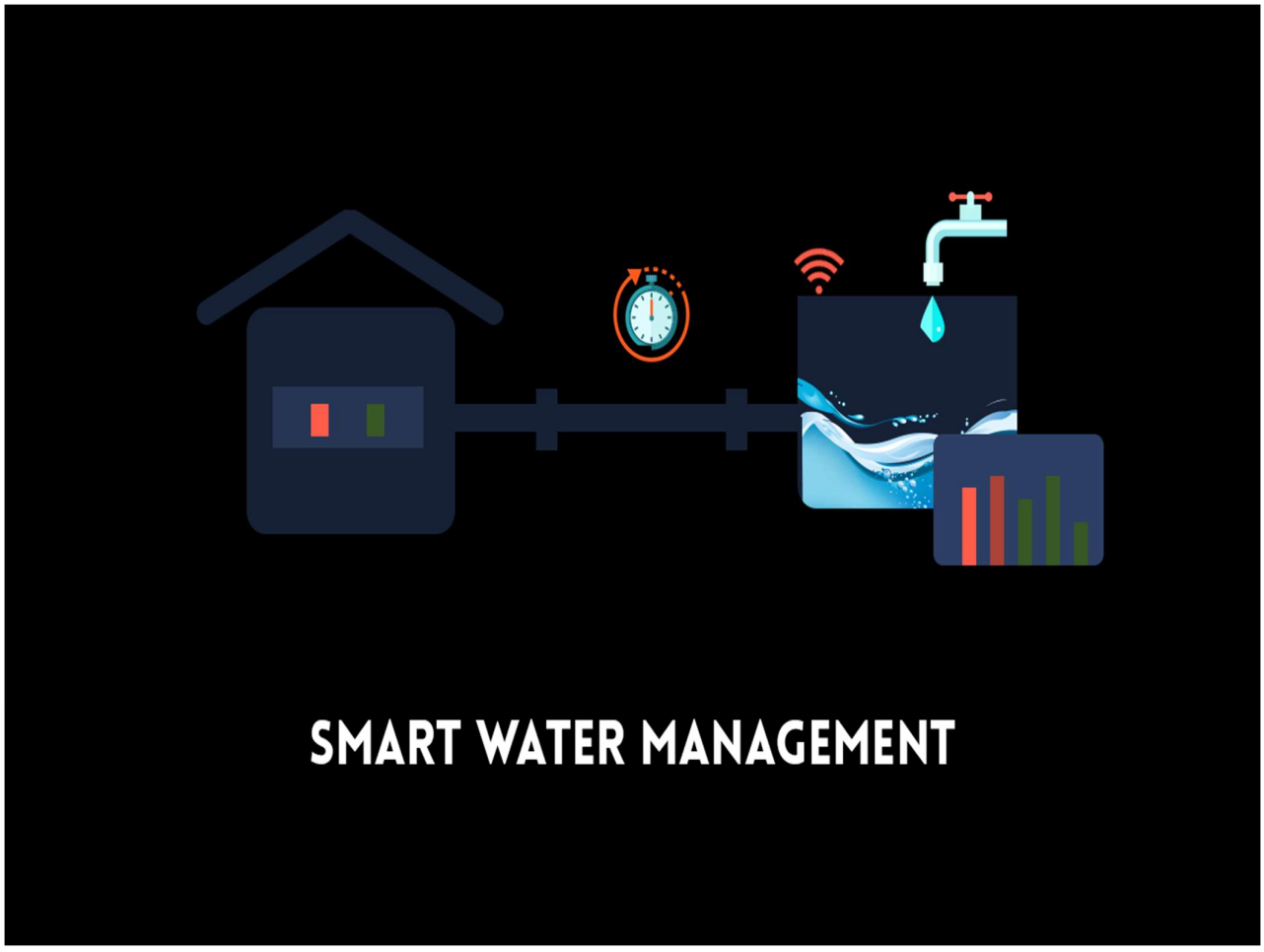

IoT based Water Management System

Abstract— **Dearth of water resource is going to be one of the crucial predicaments encountering majority of the cities in this world. The amount of wastage of drinkable water during channelling has been spotted as the prime cause, to establish some computing strategies in prompting the wastage to provide render financial build ups and saving other resources as well. Thus, ensures that this system contributes to deliver some water for our future too. This paper introduces an IoT enabled gadget which helps in administering and monitoring the consumption of water in multiple buildings simultaneously. This module can be effortlessly fixed onto desired water containers and carry on for long run. The Ultrasonic sensor is placed on the top of tank which continuously keeps track of the water level in real time, which will inform the users about the level of liquid and automatically turn on/off the water pump as per the defined functions. This figure will be regularly revised on the website, so that the user can analyse the amount of water usage and thus, control the wastage. According to the level of water in the tank, the motor functioning is automatically controlled. When the surface level drops below the threshold measure, the motor will be again switched on impulsively. This system expects to watch approximately 5 - 20 water storages based at just sole site.**

Keywords— **IoT, Relay, Ultrasonic sensors, NodeMCU(ESP8266), Wi-Fi, Water Tank..**

I. INTRODUCTION

Water is very precious and needed for many and every activity. Conservation of water is, similarly, important and has adverse effects otherwise. The storage of water for the domestic, industrial, agricultural, or other such needs is especially important. Safe drinking water is

becoming more polluted and injurious due to increasing population and their greedy demands for urbanization, industrialization, and so on. Consequently, there is a call for of some greater approaches in monitoring the water standard. For inspecting the water quality manual efforts were needed for examination. Such approaches require more time and no longer be efficient. Also, at the household level, some people turn-on the electric water-pumps and set off to work or even go to sleep, neglect to turn-off the mains when the water container is full. This ends in wastage of water and often flood. On some moments, when the tank or reservoir are placed on top of the most buildings, over the time, studies say that the weight of the tank can affect the building structure. It can also be a form of pollution to the environment and a form of wastage especially in household where a borehole cannot be afforded. Thus, the need for a continual and dependable water supply is important for ones needs [1].

As the world grows observing the behaviours and the yearning demands, there is a need for ingenious replacements, for the difficulties prevailing in the present world. This thesis focusses on contribution of an IoT depended solution for every single issue mentioned previously. IoT is the diminutive for 'Internet of Things' or call it as a machine to machine communication method. This aims at constituting a nexus for pulseless objects, devices experience communication with each other with least or no human intervention, they will be able to acknowledge the wish of humans and impart with the needful assistance. The expectations of IoT is not restricted to the typical commodities such as e-gadgets. IoT aspires at affixing altogether in the internet. These things would be capable of interchanging some unprocessed data. The inanimate gadgets will process these data and precipitate the needed information [2-3]. Once the facts are generated, it will be implemented soon.

The IoTs can be applied for associating devices like smartphones, Smart-TVs, laptops, computers, sensors to the internet where the gadgets are interconnected to permit latest forms

of communication between those objects and users also. Establishing IoTs has refined remarkably in the past time. The aggregate of appliances connected to the network are steadily growing. The valuation of such direct communication over mobile networks are predominantly inexpensive than fixed networks. At present, the masses can have such connectivity at any moment for their desired services. The Internet of Things is being used in numerous tracts from agriculture, transportation, energies, security, financial and healthcare services, portable devices, automation to prominent nanotechnology [4].

Intercontinental water usage has eventually grown by a factor of six over the bygone century and continues to extend steadily at a toll of about 1% per annum with climbing population, economic flourishing, and fluctuating consumption behaviours. A study concluded that the living beings could meet a 40% global water undersupply by 2030 under a mediocrity scenario. It is also assumed that by 2050, approximately 685 million of the total population by then, living in across 570 cities will be facing some further reduction in availability of freshwater, of at least 10% and that too because of climate changes [5]. When there is not adequate drinkable water for a population, the ultimatum of aqua crisis is comprehended. The United Nations and many other world institutions contemplate a diversity of regions to have water plight of global worry. Other organizations, alike the Food and Agriculture Organization, claim that there is no water predicament in those locations, but necessary steps are still to be taken to avoid one critical point [6].

The declaration of Smart City Mission by Government of India with a prospering vision concerns to an city development imagination to combine the multiple Information and Communication Technology (ICT) and IoT solutions gave an inducement [7]. By using water monitoring system, we avoid the water wastage, power consumption, can easily prevail the water for our generation.

This system monitors the water level of the reservoir and automatically switches ON/OFF when the tank or container is Partially Empty or Full. Here the waterline of the water storage tanks is reflected on the website. But here the model being designed according to the circuit is used to discover and control the accurate water level automatically in an overhead tank using NodeMCU controller can avoid the overflow of the water. The water level sensor is made with an ultrasonic sensor mounted on the top of reservoir. Conventional water tanks can neither monitor nor control the water level in the tank. As of now, the water level must be checked manually and reloaded as per the requirements.

By emphasising on the mentioned issues, our prototype develops an economical set-up while monitoring the water level of multiple reservoirs at different locations in real time, certainly with automatic water level detection and refilling of water storage system in an IoT environment.

II. LITERATURE REVIEW

Since safeguarding water along with other resources is extremely respected in current scenario, various authors have been suggested several solutions in accord with the worries adjoining them. A perky discussion for students, engineers, researchers, and in public administration is IoT based water monitoring. These configurations have proven that demonstrated the human interferences can realize significant surge in efficiency. The vogue of IoT related innovative technologies are emerging due to its potentiality in evolving various practices and only some part is available at present in the society. Its domain includes healthcare facilities, logistics, intelligent habitats, and numerous others [8].

Imperative approaches have been employed to restraint the wastage of water resource and produce superior economic achievements. Furthermore, corroborate the conservation of

nature and water cycle in such a manner that can be moved on the resources to yonks. A system composed of Arduino for the automated principles of supplying of water into the tanks with the assistance of sensors which can notice the water level in the container. The pumping system will operate as per the defined indicators for certain levels of water, and in parallel, on a LED display the status is displayed for the observers. Further, this system can be elongated to automate the process of fetching water from the sump. Aforesaid action plan for computing the level of water with the aid of sensors in the sump, possibly used in such situation if such system senses the water level to be less, then it averts the pumping motor from functioning to make sure of the well-being from dry running. A notifying sound could be initiated in such cases alerting the user concerning the issue [9]. Here came another prototype model for this topic, developed for detecting water level using the internet. A central device like microprocessor connects to the internet and receives orders to control sensors, with the help of a server capable of managing the users and their devices comprising of a compatible Android application acting as a user interface [2]. Another author suggested a method assisting to realize the benefit of Bluetooth modules and how efficiently it can be produced as a compact device [10].

Similar tract dealing with concise elucidation of enabling Arduino in the process of automating the homes. In comparison with other existing systems using the Bluetooth method, the restrictions were also analysed in demonstrating that Arduino with Android converges for a finer method in automation. The related specifications for the applied software according to the usable hardware arrangements are also explained [11]. Eventually, a GSM based arrangements came into action, in which an advanced technique is brought forward which constantly keeps a record and is capable of handling the functionalities of

system using their mobile network, as even in case of certain water level in containers like a raised water tank, the operator can report to the registered module towards recognizing the particulars of a peculiar tank, as well as capable of regulating the pump impulsively by turning OFF when the commentative amount of water filled up and sends the message back to the handler mentioning the status of tank. Hence, its focused in managing with reinforcement of ultrasonic sensor accompanying the GSM technology [12].

In another presented paper based on SMS notification, it is a smart system as every single process happens to be automatically updated by the micro-processing unit, via GSM technique. So, this mechanism is depressed of somewhat noise also has an efficacious converting action. Broadening its implementation, safety alarming system is considered as a suited application. Thus, intended arrangement is conceivably exercised at home, offices, and even in industries. As introduced, there is no connection between the reservoir and another tank, subsequently, disclosure connecting the two can push the project to highs. Additionally, a GSM module is possibly a substitute to a digital telephone. The system mayhap be improved into a two-container architecture with a WWAN (Wireless Wide Area Network) connectivity intermediate the regarded vessel and the repository. Considering every element, even being the intelligent system, countless opportunities meant for the refinement, to finally make it be smarter [13].

One of the supervising systems was generated for quantification of water levels, and it is devised of ultrasonic sensing element, PIC micro-controller, and GSM module. The ultrasonic sensor computes the interspace from the sensor to the top of contained fluid. This system suggests the evolution of water measure monitoring system by amalgamating the GSM module to notify the user via SMS(Short Message Service) when the liquid has set foot

on the deprecatory level and it will automatically switch OFF the electric water pump. It is realizable to observe the quantity of water in any suitable time. This relates to a cloud platform, so the things around us can be accessed in any device, anywhere in an acceptable manner. Some practices using apparatus like sensors require enormous volume to be stored, big data with massive calculation capability for dynamic processing. This dissertation presents a technique of automation in which the cloud utilizes the SHA-1 and Naive Bayes algorithm [14].

Similar disquisition focussing on the blueprint of such equipment obtainable all via SMS, once again a glimpse of ultrasonic detector, for determining the water level, and a microcontroller to manage all connected electronic pieces. Anew SMS is used to outline the quantifying. The utmost goal of this research is to develop such type of structuring capable of calculating the water level automatically. Aggregate of the measurements would be forwarded to the registered mobile number of users at every request [15]. Then came a work on real-time wireless controllable system for discussed purposes using Zigbee 802.15.4, in which the framework consists numerous components, some are - water calibre sensor, watermark sensing unit, modem for GSM, XBee, along with a compatible DBMS. The data goes from sensor readings to the database, and through the nodes like routers, these data are transferred to main end tool called XBee. Using C-sharp programming language, details are gathered. And then from the machine using a GSM module, a SMS is redirected to observer's machine and accordingly alert is notified at the critical levels. Database manages these data for future implementation of an expert system through a systematic supervising algorithm [16].

In another paper related to low-cost electric elements, it clarifies the benefits of such mechanism and proposes the wireless based monitoring i.e. Wi-Fi along with the Arduino [17]. Among these documents, presenting the concept for a good design implementing a wireless real-time framework conducted on a popular microcontroller namely Arduino Uno. Alongside MATLAB-GUI platform, the hardware structuring as per the proposed plan is conducted to screen the fidelity of the complete layout, thus building it in an unsophisticated, economically conformable [18]. Later, another cost-effective dynamically monitored process in IoT was established. This procedure comprised of different sensors used for pH counting, turbidity, and mainly focussing on the water level sensors as our concern. Raspberry PI is used here through which the accounted data is sent to the cloud, making it more efficient with a Wi-Fi module [19].

One more composition set forth the existing water line observing system with infrared sensors along with an android smartphone to command the devices using a wireless network as a communication medium. Thus, develops a friendly interface between the Raspberry Pi server controlled smart device and android application [20]. An exposition on IoT Based Water Quality Monitoring System, practical to perceive the quality of collected water done by MCU with Zigbee module, accustomed in creating a spatially disseminated committed network of sensors, a minimal priced but efficient module. Moreover, monitoring the data in that IOT network is accomplished with raspberry pi and cloud computing [21]. Demonstration of the automating procedure using the secure Wi-Fi technology acting as a server. Several characteristics are been recorded in parallel, like temperature, humidity, motion detection [22]. The need to ingress and oversight the IOT devices is exceptionally

discussed including the security motives inclusive of evading the cyber-crime and other authentication mechanisms are presented like:

i) Tagging method to acquire control, ii) Tagging assignment, iii) Selective Publication; finally describing the steps of the algorithm followed [23].

Another discourse demonstrated a water management system for an entire campus that works on an ultrasonic HC-SR04 sensor which sends the pulses at 40 kHz onto the waterline and rates its reflected waves which crosses the threshold. But such approach is efficient when the gathered indications are larger in amplitude and ranging within 4km and is inadequate for oversized dispensation tanks that can be up to 8m in depth [24]. A relatable theory explained that its intention is of the littlest expense inclusive of a concatenated sensory unit that grants internal surveillance of the water-quality. Operating with an internet connection, pertinent and some forewarning information are sent to a virtual server, later, this proof surely be obtained by the client end. A ThingSpeak, open IoT platform allots an alerting system that may be beneficial for residents as well as industries. The notifying signal is posted into some real time social media applications, here it is conveyed through Twitter, in which the level of water is open on the control panel [25]. Further simulation model was submitted, this was another machine-driven observance technique. A dominant, adaptable, reasonable, and intelligibly configurable system which may unravel the water wastage contentions. The cyberspace predominately found water table scrutiny and prepotent system are frequently drawn, by virtue of which the computation is oft governed from remote via the web still quite disparate heterogeneity of widgets. This could be having a substantial gratification in this perusal for the financial administration of water resource [26].

III. PROPOSED APPROACH

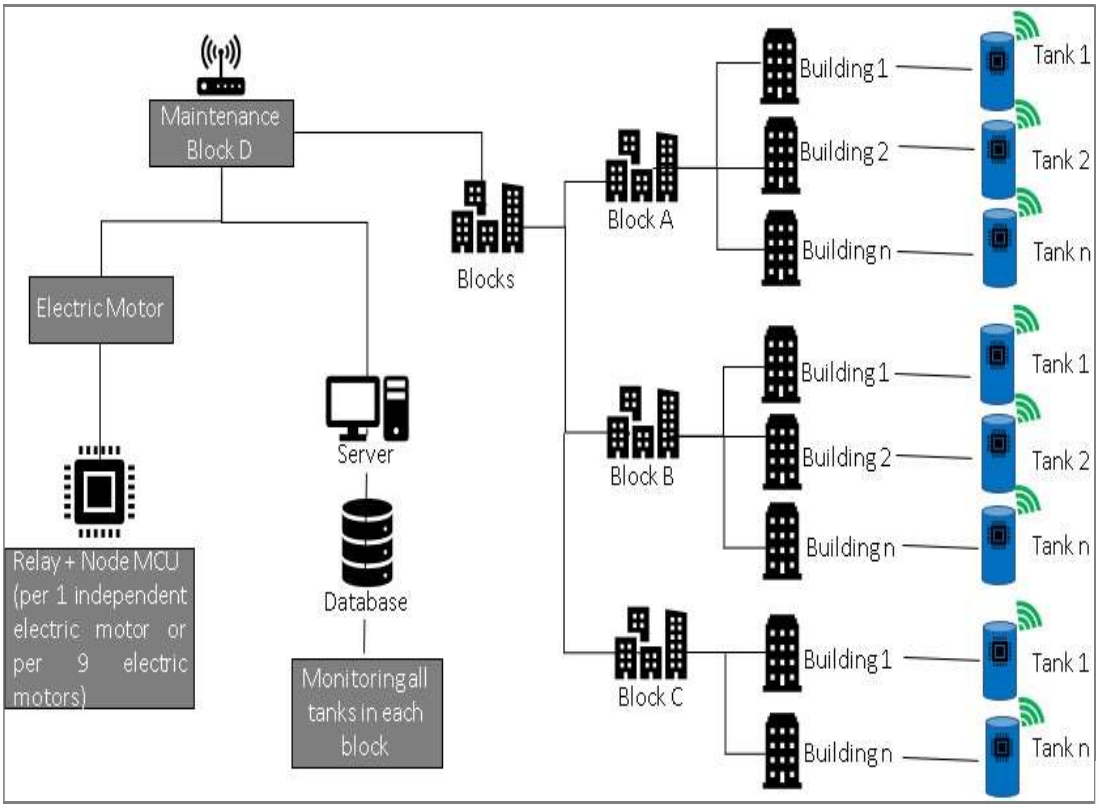

Fig.1 Model View of System

The aim is to develop an apt prototype that revolves around the water storages located at universities, cooperate campus, big societies as well as industry level. This system can also be used at single household, small societies, and village level. But the maximum efficiency of this system can be highlighted at cooperate level. According to the model view as depicts in Fig. 1, for a huge corporate campus built up with many blocks of similar planned buildings. And noticeably these buildings must be accommodating individual water storing facilities. Withal this, a central server is positioned at the maintenance block where the electric motors for the water supply to the tanks are serviced. Suitably, each building is considered as a single node and all such nodes are bridged to a leading command centre which can superintend the working of every junction.

For this model, availability of a wireless internet connectivity for the working of complete composition is mandatory. There are two generalised connection arrangements to be structured: One at the tanks and the other at the water pump maintenance area. So, NodeMCU (ESP2866), a microcontroller is connected to the active Wi-fi network for an internet connectivity. Each tank must be in reach of Wi-Fi signal for internet connection. Another requisite concern is of the electric motors in the maintenance block, these should be in reach of the Wi-Fi signal range for interconnectivity, so that the MCU administers the connected relay to switch on/off the motor/s. The ultrasonic sensor positioned in the inner side of the tank (high up), must be interfaced with a NodeMCU past which the data is relayed to the nearest station. Here comes the requirement of distant transmission technique as the least separation between the transmitter (sensor located in the interior of the tank) and the recipient (at the maintenance block) is not judgeable, so these must be in the same wireless network connection.

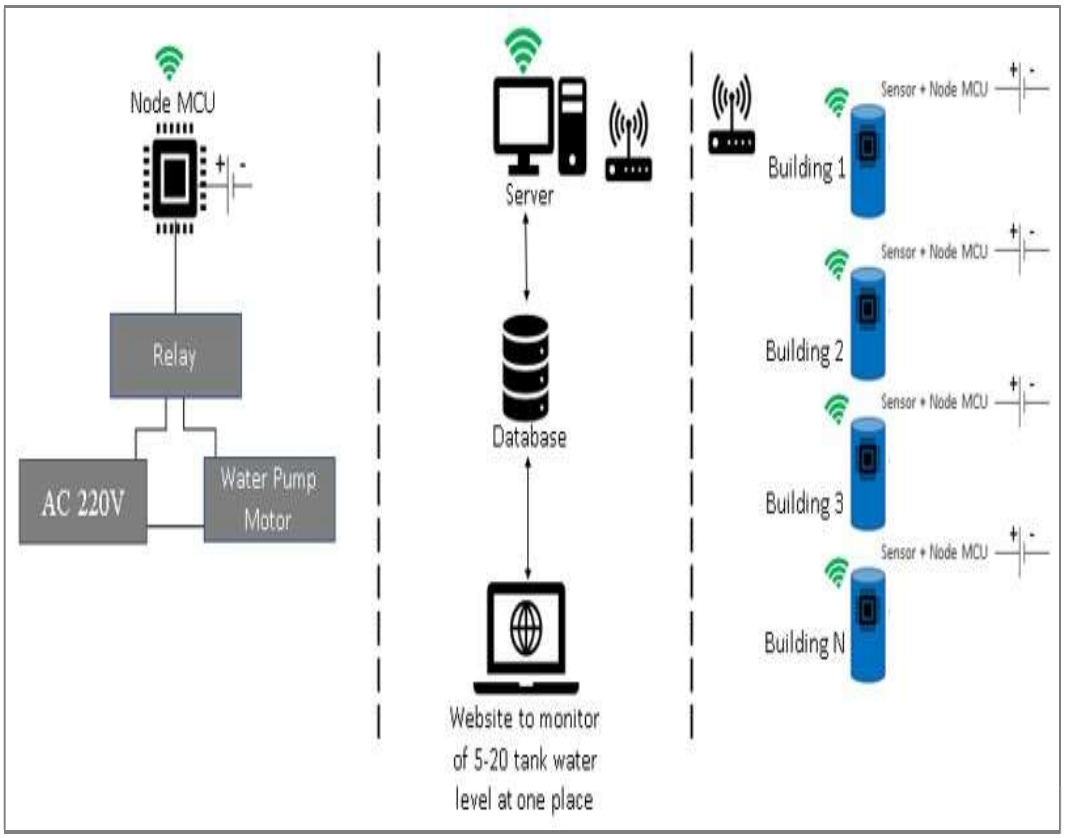

Fig.2 Connection arrangements

Following the catch of signals from respective foremost nodes, the task of main office comes into action. The mechanism decides whether the electric water pump needs to be switched on/off. So, for this purpose, a pre-set waterline is been contrived i.e., beneath an inevitable approach of the water level, the electric motor pump switch of that particular tank/building/block gets to be turned on and surpassing a threshold level, the motor gets turned off. Such pre-decided threshold levels differ from tanks to tanks depending on the quantity of water those tanks can bear or the demand of water in that locality. Now, in the wake of the pronouncement of switching off or on of the electric motors, this action must be sent as a direction to the local station tank. So, the central station transmits the action to that specific node and then in turn, microcontroller responds the data with up-to which extent, the tank is being loaded or unloaded with water. These water level signals will be accumulated into the server as a part of mechanism, to check the previous as well as current live data. A website is also hosted on this server for monitoring the position in waterlines of all the tanks installed in the campus along with the status of functioning of water pumps.

Anyone can access this website on any device from any location. This system intends to monitor 5 - 20 water tanks located at a single site.

Devices at the tank take water level reading of their tank independent of each other, 24 * 7, and send record to the server through Internet. Server have many databases divided according to blocks and each database has many tables for each building or can have many tables for each tank. Each table stores records sent by their respective building. Thus, maintaining all the records at one locus.

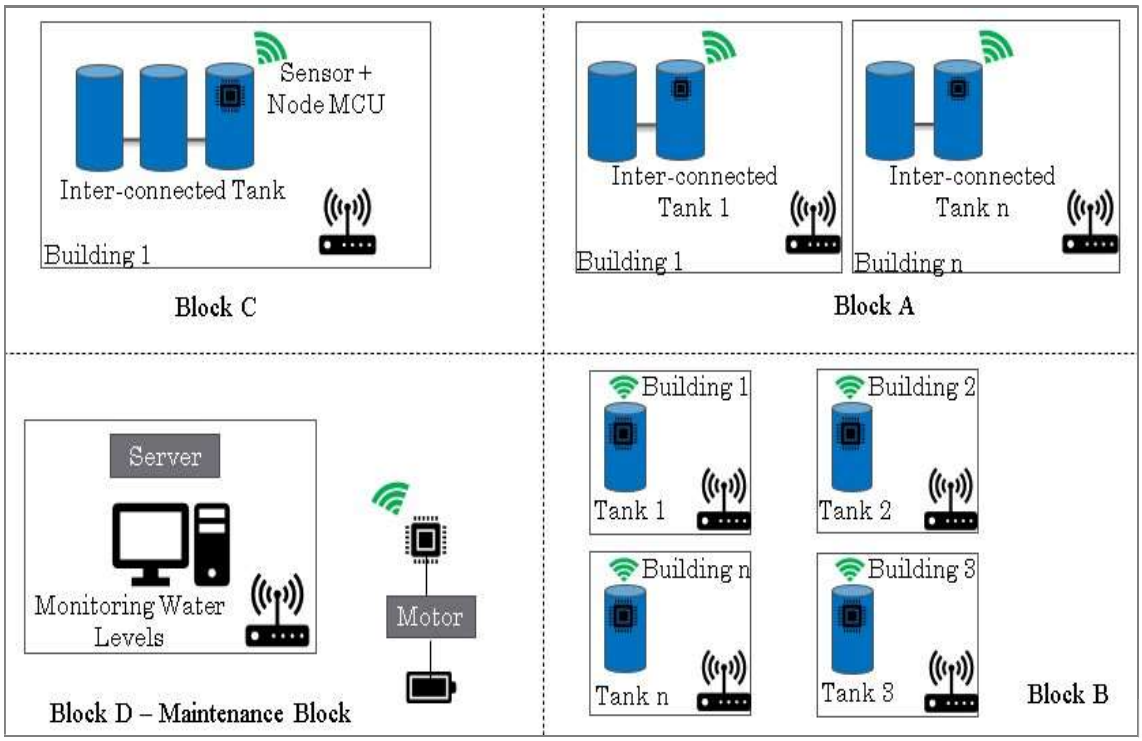

Fig.3 Bird's-eye view of setup

The very system is automated, so one just has to setup the devices at its designated place and configure the account for website and database to store the records. Then, no one must do the tiresome task of switching the systems and wait for a long time or just fail to recall. This does all task automatically, reads the water level and makes decision to switch on or switch off the motor pump. Thus, making the model highly flexible and the scalability of its use varies from place to place, form a small household to a big cooperate campus and universities.

IV. RESULTS & DISCUSSION

The waterline tracking system exhibits the water level and determines the operating of electric motors. It should be having a suitable internet connectivity to transfer the data instantaneously. This kit must be fixed inside the tank on its upper side. Sensor data must be

sent to the database, SQL server. Then the stored data must be repossessed in the actual timespan to unveil the accurate volume onto the website. The closeness to the crest of water (being filled or emptied to/from the tank) from the sensor is the lone estimation entailed for this system.

As overviewed in the preceding section, the implementation is an exceptionally low capital in comparison to present on sale systems. This mechanism incorporates the clients to be redundant to hold on their schedules and stick their views on the tanks to inspect whether there is an overflowing scenario of water, as they can be overseer and keep up the apparatus remotely through a user-friendly website. More to this, seeing that it is computerized, the user's presence to control the motor manually is not at all recommended.

V. CONCLUSION & FUTURE WORK

The preferred execution might be usable for wide-ranging monitoring of water resource, like in considerable firms and communities. This paper has presented the principal intentions. Furthermore, this involved in scheming and maturing of an automatic water level controllable system exposing the fitter way of information processing architecture that interpenetrates for the interfacing scheme. Under the aegis of the generated signals by the sensors and by analysing with some tools, a further innovative system can be built to predict and make progress for necessary measures by itself if an emergency occurs. Introducing machine learning algorithms to this patch can promote it to a vastly efficient and more dependable product.