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Automatic "Anti Water-Flooding" Supervisory System, Using Wireless Water-Level Sensors

Dr. Preeti Mulay

Symbiosis Institute of Technology, Lavale, Pune-15

Abstract - Water is the major natural resource. In every day busy life of people to remember to switch of the water-tap in bathroom / washroom is very small task for them and everyone tend to ignore it. But at the same time, it is obligatory to save water even at every household and tap + bucket / sink /basin level. The aim of this research study is that the existing tap should interact with bucket via sensors and stop overflowing of water. This way not only water, but heat / electricity and individual human energies are banked and every individual will be part of global social initiative. This proposed "anti water flooding" idea can be extended further by acquiring water and power time series data. This acquired data can be analyzed further using machine learning concepts for decision making, predication of water utilization per household.

Keywords - *Water-Level Sensors, Tap+Bucket, Electricity / Power, Energy, Wireless Communication.*

1. Introduction

Water Sensor water level sensor is an easy-to-use, cost-effective high level/drop recognition sensor, which is obtained by having a series of parallel wires exposed traces measured droplets/water volume in order to determine the water level.

Many researchers worked in the broader areas like water tank and motor controls using sensors. All researchers have given very innovative large scale working models. It is also essential to work on small scale, tap+bucket level to save water. To add feathers to "anti-flooding" systems, especially in Indian summer months, it is necessary to work on tap+bucket, tap+sink, tap+basin levels. The magnificence of this research work is not only to save water, but electricity, heating energies, human energy and also to reduce stress due to flooding of water by using the existing set of tap+bucket / sink / basin with added sensors. These sensors will interact with each other and stop water after suggested levels are reached. This way overflowing, flooding can be avoided. Flooding due to water at home, is very common in summer season when there are restricted timings for water supply in a day. With the human nature tap remains ON and when the water supply is resumed flooding, damaging furniture, cleaning / extra work, damaging building structure may happen. To avoid all such issues, proposed system will be very effectual. Mind map as shown in fig 1.1 gives the pictorial depiction of the entire system.

2. Working Model

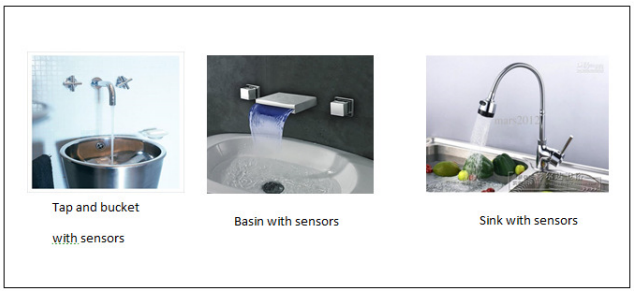

Fig.1.2 Applications & Architecture of Automatic "anti water-flooding" supervisory system, using wireless water-level sensors

Fig 1.2 shows the various household equipments which will be benefited by this research proposal, rather, these are the equipments in every house which may be useful for anti-flooding system suggested here.

Fig. 1.3 describes the flow of the system i.e. overall working of the system. In addition to suggested system, during summer to avoid stress and enjoy available (restricted quantity of) water, timer activated bucket filling can happen, so that every individual will enjoy bathing, absolutely unmanned way to have bath-ready washrooms and save water (that too lukewarm water, for bathing).

3. Related Work

Authors in [1] discussed a wireless solution of water level control system. This work by authors is based on SIEMENS LOGO! 24RL Programmable Logic Controller (PLC), RTX-MID-3V transceivers, converters and a pump controlled by electrical motor. In this research work is it feasible to visually signal the maximum, minimum levels of water, also correct functioning of motor, using LEDs connected to PLC-s outputs. The most economical solution is suggested by authors in this paper, with water level controls. Authors in [2] discussed about the sensors that can be used to detect and control the water level. The sensors are also related to temperature and pressure that helps to control the wastage of water and electricity. [3]"This sensor works as a capacitor coupled with a capacitance to frequency converter and measures water level at an adjustable time step acquisition."Point no. 3 is connected to the sensor of bucket instead of speaker [4]. Extension of this idea is feasible with use of [5] which deals with one click button details related to water level. [6] talks about adding one additional external unit to existing tap by which the existing tap is reused and becomes smart tap. This smart tap controls the water level by sensing hand movements. This sensor unit will read the level details given by LL6-Liquid Level (Ultrasonic) sensor [7] and stop the water supply immediately by closing the tap. LL6 is a battery operated level sensor, which can be connected to wireless gateways also.

OleumTech WT Series Wireless Liquid Level Transmitter - Ultrasonic is a self-contained, battery-powered liquid measurement solution is non-contact and has no moving parts and is made especially for the remote, rugged environments without access to a power line.
This liquid level sensor utilizes field-proven ultrasonic level sensor technology with high resolution of 1mm and is ideal for monitoring water storage tanks of up to 12 ft. It provides mounting hardware with 6-inch adjustable compression fitting.

All WT Series Wireless Transmitters are equipped with a local LCD display that can be used for reading process data and for programming the device. Thus, cables and PC are no longer required for quickly setting up the device. The Wireless Ultrasonic Liquid Level Transmitter is intrinsically safe (certified for use in Class I, Division 1 C1D1 Wireless (Zone 0) hazardous areas). It can be operated in a hazardous environment with or without the enclosure without the risk or fear of causing an explosion. This wireless end node transmits collected data to a Wireless Gateway that supports Modbus. The transmitter uses license-free, secure data transmission with a range of up to 7500 ft. Range (2.3 Km). [7]

4. Data Communication Algorithm

1. When the tap is open LL6-Liquid Level (Ultrasonic) sensor, attached to tap gets activated.

2. When water level reaches to OleumTech WT Series Wireless Liquid Level Transmitter - Ultrasonic sensor of bucket, based on depth of bucket then sensor get activated and send signal to the sensor of the tap. 3. After receiving a signal tap sensor close the tap.

The delays are not considered in this proposed work as the distance between tap and bucket / tap and sink is negligible for available wireless smart sensors.
This proposed work can have additional facilities to acquire data, related to water usage per household. This acquired data can further be analyzed to predict water requirements in future.

4.1 How Automatic Sensor Tap Works

As mentioned in [8-12] automatic sensor taps combine five key components: Solenoid valve, infrared sensor, power source, and a tap unit/shell, bucket with wireless sensor for communication. Solenoid valve: The working principal of this valve involves converting electrical energy into motion, the solenoid physically starts and stops the water flow. Autotaps [8-12] products use "latching" solenoid valves. The researchers of Autotap explained "*The solenoid valve is initially energized to start the water flow; the plunger is driven into the range of a permanent magnet which in turn holds the plunger in the "open" position. In order to return the plunger into its original "closed" position the solenoid is once again "pulsed" but this time by reversing polarity*", as shown in fig 1.9.

Modified working of infrared sensor: By sensing an object like human hand in front of the tap, sensor sends a signal to the solenoid valve to initiate the flow of water. Flow of water from tap continues till sensor connected to bucket will not send message to stop the flow.
Power source: in this proposed work wireless communication between tap and bucket is discussed, by using battery operated sensors. (Powered by regular AA batteries Alkaline or by mains via a 6V transformer. Batteries). The complete architecture of proposed system is given in fig. 1.10.

4.2 Remote Communication Steps

Step1: Design interactive application software for remote PC or mobile should display data in table format or in the graphical interface for integration of the wireless water level monitoring.

Step2: Display the available local connections and the stored remote connections through the internet.
Moreover, Display different data of wireless automated controlling system by different sort (sensors/actuators in one node, all devices in a room, all devices in an apartment/factory).

Step3: Display the whole network structure for the maintenance user [15].

5. Results

Premises	Usage of water	Waste of water	Waste of electricity
house	50 l/day	3 l/day	5 rs/day
Building(10 flats)	500 l/day	30 l/day	50 rs/day
Society (6 building)	3000 l/day	180 l/day	300 rs/day
City (50)	15000 l/day	900 l/day	1500 rs/day

The results in the above table of the proposed system are approximate calculation of usage of water and wastage of water and electricity related to particular premises. In portion 4 of this paper the suggested sensors are: LL6-Liquid Level (Ultrasonic) sensor, attached to tap and OleumTech WT Series Wireless Liquid Level Transmitter - Ultrasonic sensor attached to bucket. But in addition to this it is feasible to make use of Arduino circuits also. Easy to complete water to analog signal conversion and output analog values can be directly read Arduino development board to achieve the level alarm effect [13-15].

5.1 Description of Arduino Circuit

- Product Name: water level sensor
- Operating voltage: DC3-5V
- Operating current: less than 20mA
- Sensor Type: Analog
- Detection Area: 40mmx16mm
- Production process: FR4 double-sided HASL
- Operating temperature:10℃-30℃
- Humidity: 10% -90% non-condensing
- Product Dimensions: approx. 62mmx20mmx8mm (L*W*H)
- Weight: About 3.5g

5.2 Suggested Sample Code for Arduino

```
void setup() {
  Serial.begin(9600);}

void loop() {
  Serial.send("Water level Sensor Value:");
  Serial.recieve(analogRead(A5));
   delay(10); // no delay, as the distance between tap+bucket / tap+sink is negligible.
}
```

Fig 1.11 showing Arduino sensor [9]

6. Conclusion

Water is one of the most important basic needs for all living beings. But unfortunately a huge amount of water is being wasted by uncontrolled use. Some other automated water level monitoring system is also offered so far but most of the method has some shortness in practice. To overcome these problems this proposed efficient automated water level monitoring / supervisory system is suggested. The sole intension of this research work was to establish a flexible, economical and easy configurable system which can solve our water losing problem. Existing tap, buckets, wash-basins can be equipped with sensors to have economical solutions.

7. Future Scope

This concept is extended to have all tap sensor network, data acquisition and prediction mechanism, with data mining, incremental-learning (advanced machine learning concept). Wash basin / sink and tap communication: during summer days when water management begins, timely water supply is organized, it is observed that people / maid tend to leave the tap open accidently. In absence of human beings when water supply starts, there is a possibility of flooding of houses, damage of furniture and wastage of water with increase stress levels etc. To avoid wasting time / energy / water tap of wash basin in washrooms or kitchen need to communicate wirelessly. Sensors need to be activated to stop the water flow from

tap. Mobile or computer app can be developed to acquire complete water and power data. This data can be stored for further analysis using machine learning concepts. Once soft copy of data per household is available, decisions regarding water requirements of society at large, can be very well managed. This could have a substantial benefit from this research work for efficient management of water.

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Preeti Mulay is working in areas related to data mining, incremental clustering and machine learning. Her PhD is related to topic of incremental clustering and incremental learning. She is MS, M.Tech in Software Engineering, completed her MS from Wayne State University, MI, USA. Her contribution to research includes research papers in indexed journal and chapters in technical book published by Elsevier.

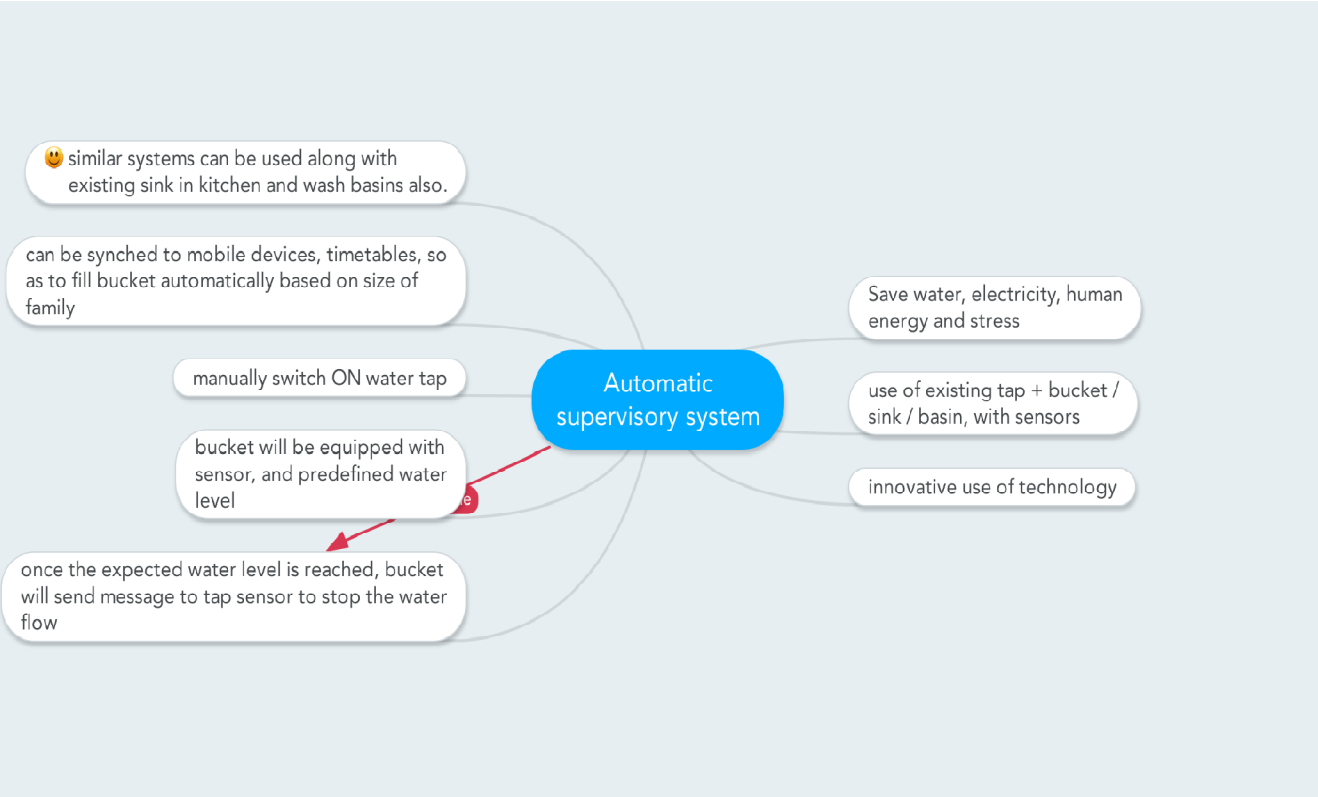

Fig.1.1 Mindmap of the Automatic Supervisory System

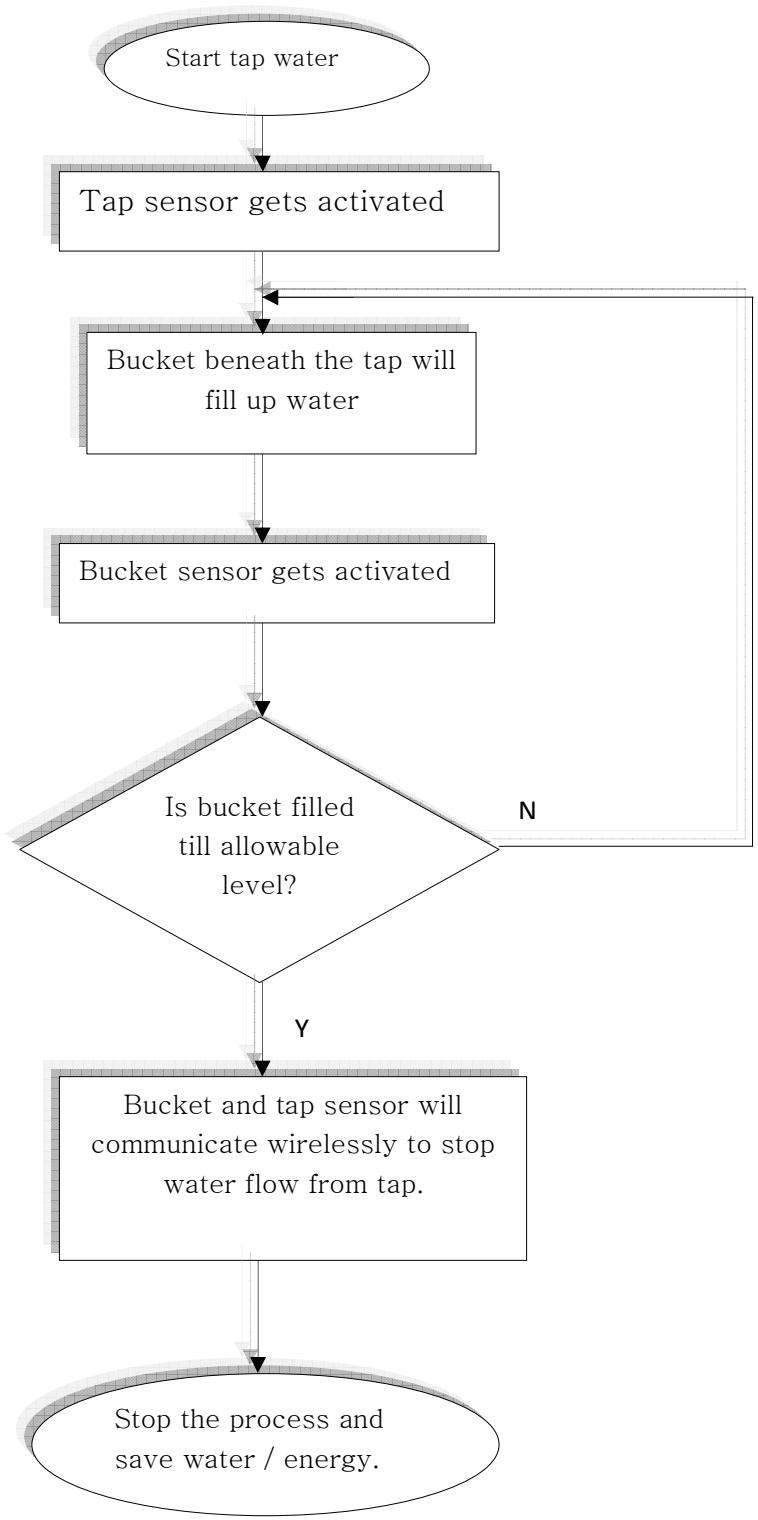

Fig.1.3 Flow diagram of Automatic "anti water-flooding" supervisory system, using wireless water-level sensors

Fig.1.4 TruBlue Sensor [3]

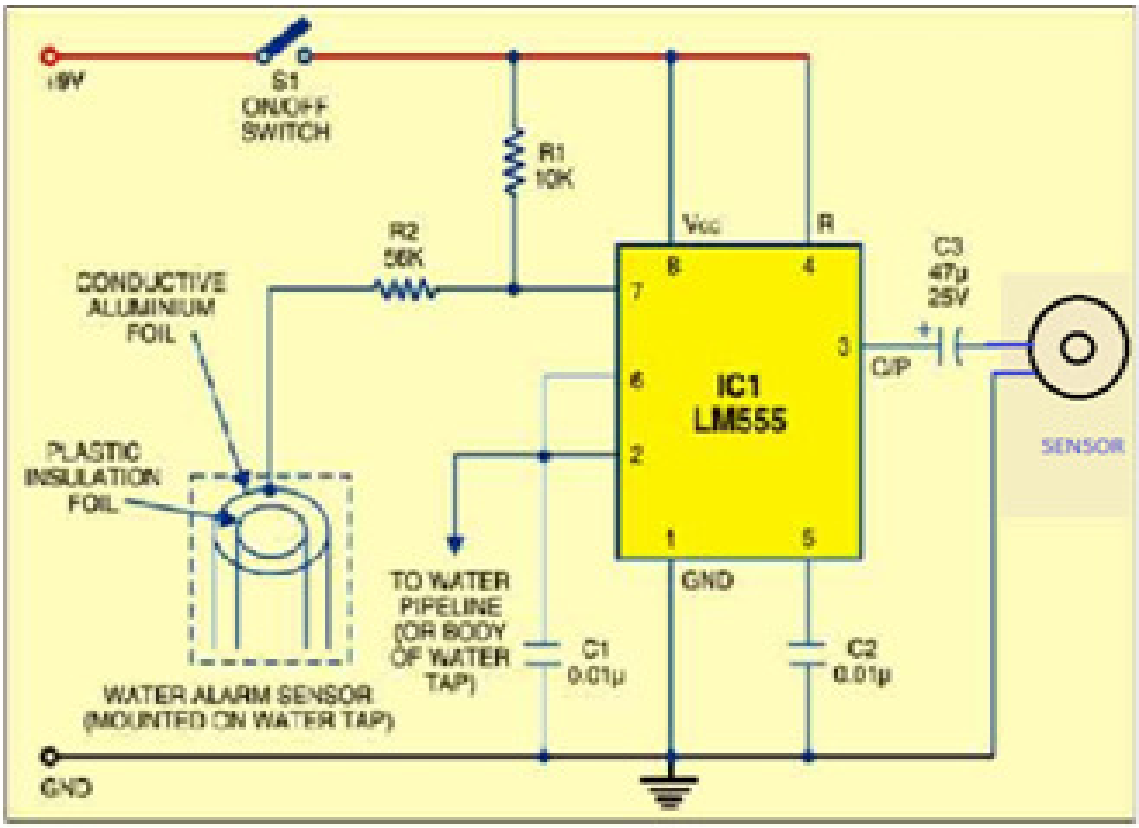

Fig.1.5 circuit diagram using IC1 LM555 [8]

Fig.1.6 [7] Ultrasonic Sensor

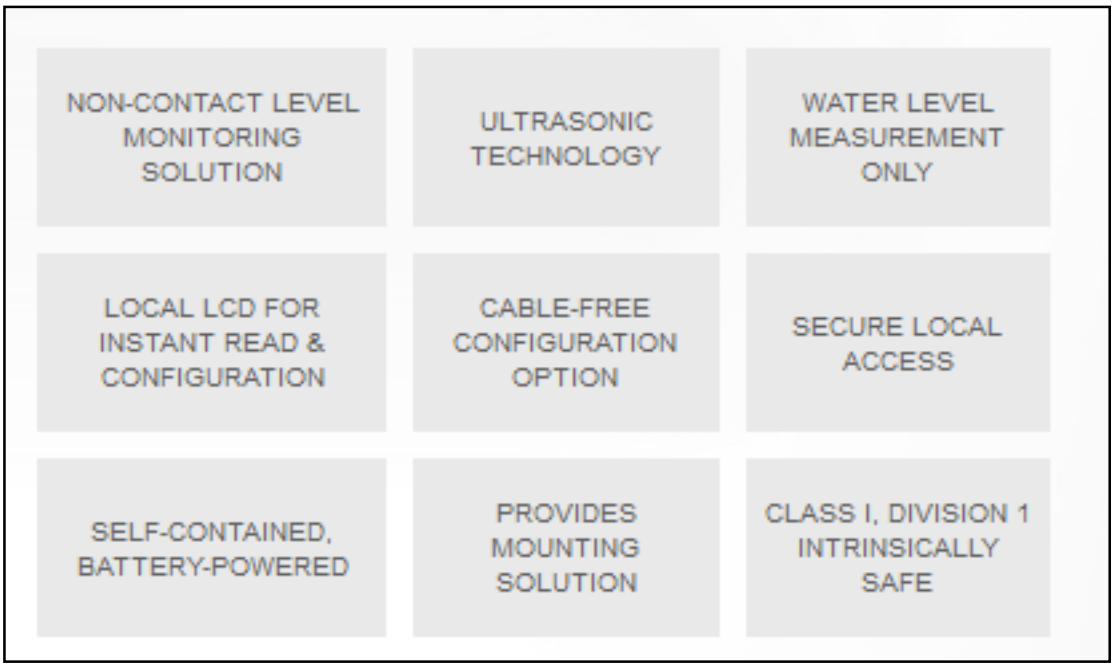

Fig 1.7 [7] Features of ultrasonic sensor

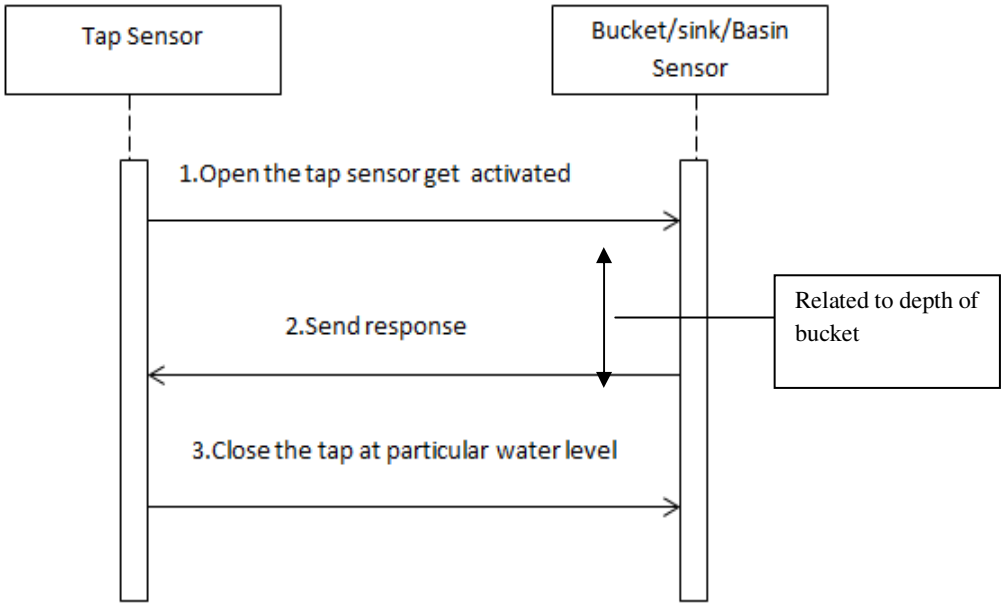

Fig.1.8 Sequence diagram for communication of sensors

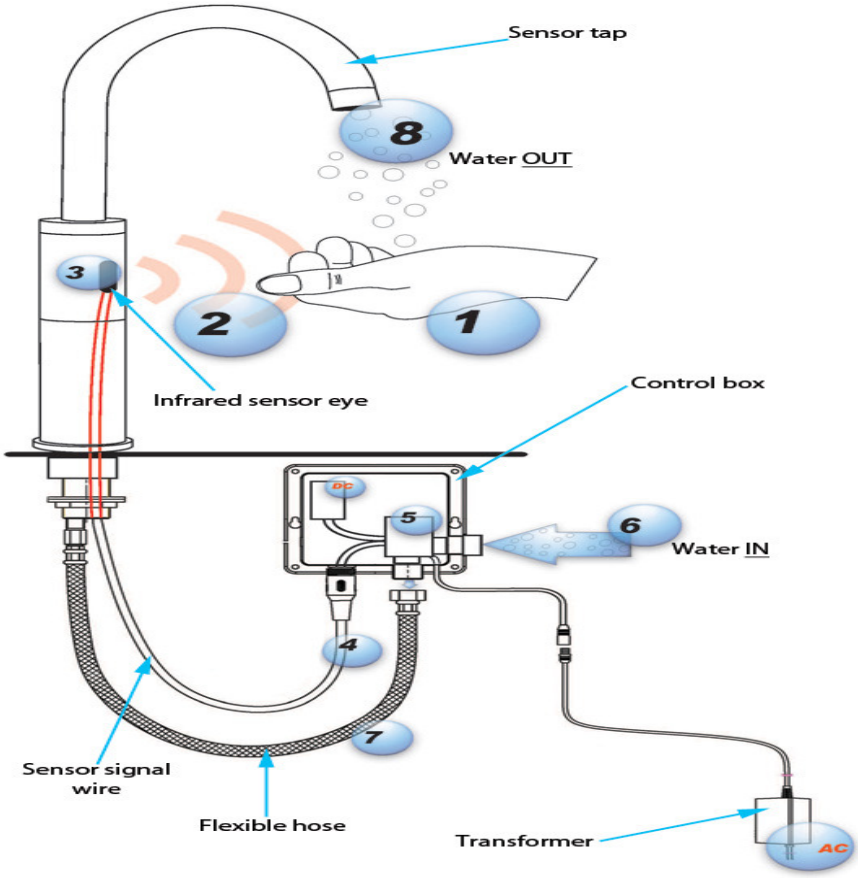

Fig 1.9 Solenoid valve [12], infrared sensor component working and communicating with bucket.

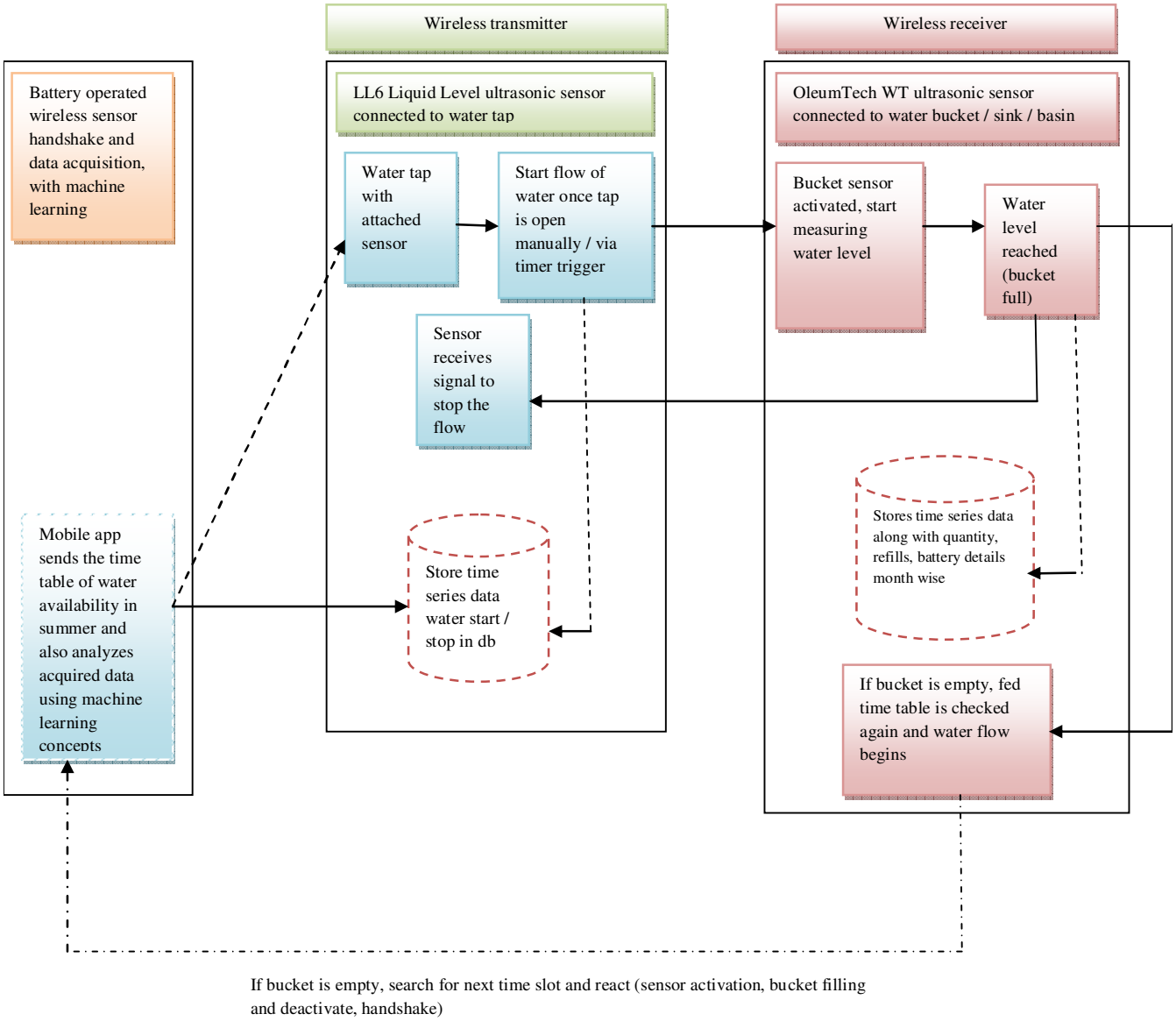

Fig 1.10, architecture of tap+bucket / basin / sink using extension of data acquisition and analysis using machine learning concepts.