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Suresh Chandra Satapathy
Vikrant Bhateja
B. Janakiramaiah
Yen-Wei Chen *Editors*

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Contents

IOT-Based Borewell Water-Level Detection and Auto-Control of Submersible Pumps

Sujatha Karimisetty, Vaikunta Rao Rugada, and Dadi Harshitha

Abstract Water crisis has been a major problem in day-to-day life. So, people depend on underground water to perform daily activities. Submersible pumps are used in utilizing underground water. Due to the technological advancement in household usage of water is increasing drastically resulting in a decrease in groundwater level. In this scenario, submersible pumps cannot reach water and the pump still works leading to the failure in the pump functioning. So, users are unable to identify the exact problem behind the misfunctioning of the pump. IOT-based Borewell Water-Level Detection and Auto-Control of Submersible pumps identify the underground water level by using water detecting sensors and sends the information to the server for Auto-Control of submersible pumps. If the sensor does not reach the water level, it will send an alert message to the user's mobile and shut down the pump automatically. The pump can be controlled over a mobile app which allows the user to control the pump remotely from anywhere. Hence, this reduces the manpower intervention and users need not worry about the functioning of the pump.

Keywords Water crisis · Submersible pumps · IOT-based borewell water-level detection and auto-control of submersible pumps (IBAS)

1 Introduction

In India, whether it is urban or rural the drinking water major source is groundwater. This is used for industry and agriculture too. The availability usually depends on recharge done automatically by ground resources and on rainfall. Due to the

S. Karimisetty (✉) · D. Harshitha
Dadi Institute of Engineering & Technology, Visakhapatnam, India
e-mail: sujathakota29@gmail.com

D. Harshitha
e-mail: harshithad@diet.edu.in

V. R. Rugada
Raghu Engineering College, Visakhapatnam, India
e-mail: vrugada@gmail.com

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rapid usage of water over the years, water scarcity has been generated. Other causes are misutilization of water resources and environmental degradation. This crisis is observed in many parts in India varying in level based on usage and season.

The water requirement and utilization due to rapid rising population and advancement in lifestyle of human along with rapid growth of utilization of groundwater in agriculture and industry resulting in reducing the levels of groundwater. Many states in India are unable to reach water levels. Though it is raining heavily there is a lack of attention of conserving water levels, efficient use of water and reusability of water.

Due to the specified issues, many times submersible pumps are failing to reach water levels. However, the consumer being unaware of the situation that pump is not reaching the groundwater level is continuously running idle. This eventually results in the failure of submersible pump. The need is to verify if the submersible pump reaches water level then only switch on motor and alert consumer on the failure of reaching groundwater levels periodically [1].

2 Literature Review

Jonthan in Water Tank Depth Sensor revealed concept on switching on automatically the pumps. This paper creates acquaintance with the preciousness of water resource and about tank control and makes [1]. Akinlalu addressed the problem related to find the depth of freshwater boreholes and the recommendation of areas to trace the location during installation time [2]. Getu proposed a system for finding water levels automatically and controlling them [3]. Poovizhi proposed a system for water level monitoring in trains for filling the water tanks in trains optimally [4].

3 IOT-Based Borewell Water-Level Detection and Auto-control of Submersible Pumps (IBAS)

The groundwater level decreases with an increase in its usage [2]. In such a scenario, the pump is activated with no water in the ground. The pump siphons air and pumps stops working and forcing the user to fix it. Due to this loophole, users cannot understand the actual problem behind the misfunctioning of the pump. The IOT-based Borewell Water-Level Detection and Auto-Control of Submersible pumps are build up with sensors to monitor the underground water level. This sends notifications to the user's mobile about underwater level.

IOT-based borewell water-level detection process identifies the underground water level by using water detecting sensors. When the ground level water decreases, the sensor couldn't reach it, it will give an alert message or notification to the user's mobile. If the pump is working in this scenario, then it will be automatically turned off without causing any further damage to pump and pumps. Hence the user need not worry about the functioning of the pump. The sensors used are cheap and best with high capacity and performance.

3.1 Objectives of the IBAS

- Consumer can operate pump remotely from anywhere and anytime using an internet connection.
- Autodetection of low underground water level.
- Avoid pump failure due to idle running.
- Send notification to users to make alternate arrangements for water if the pump cannot switch on after trying for specified number of attempts.
- Give auto SMS to plumber specified in database.

The IBAS architecture diagram is as shown in Fig. 1.

There are four basic modules of IBAS. Server Module, IBAS App Module, IOT Kit, Water-level Sensors are fixed with submersible pumps. Every module has their own importance and all together work as an integrated module.

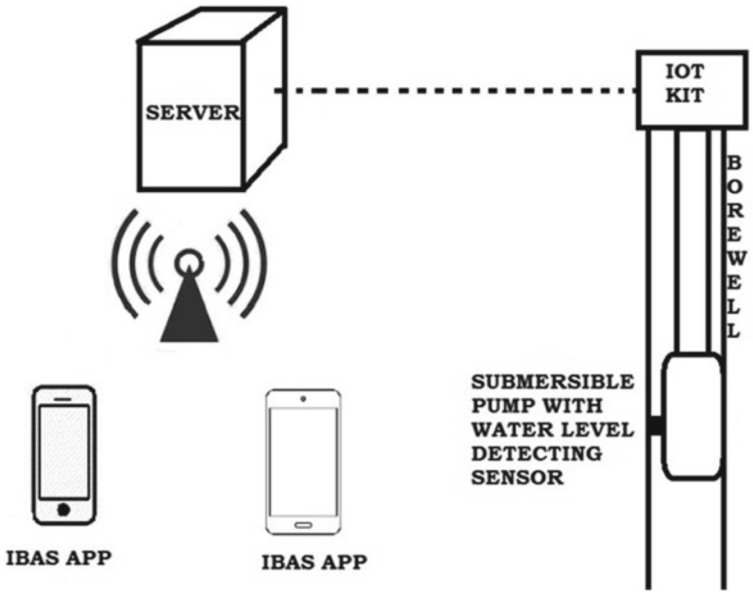

Fig. 1 Architecture of IBAS

3.2 Advantages

The notifications and alerts help the consumer in taking good decision before running in scarcity of water. This helps in maintaining good health of pump. This also saves time and money of the consumer.

4 Results

The IBAS is a device with low cost and is designed based on live requirements of the user. The mobile application is user friendly and helps novice smart mobile users operate with minimal features. The sensors used are reliable and run for years. Two types of designs are proposed where one is at low cost and other available at moderate range. This helps middle class and high class to make a choice in choosing the model. This saves time in measuring water depth and switches on pumps.

4.1 IBAS Server Module

IBAS server module is installed in any server and data obtained is periodically posted on server is used by the IBAS App for deriving solutions for queries on water level for monitoring the pump and for analysis purpose. The data can be used for Analyzing water levels of a particular resource seasonally and eventually this is used for regularizing the water supply. The cautious measures can be taken to handle situations such as going into scarce situations. The workflow is shown in Fig. 2.

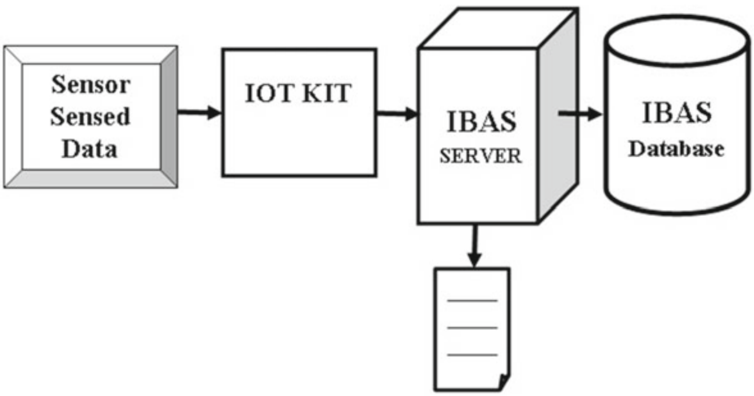

Fig. 2 IBAS server workflow

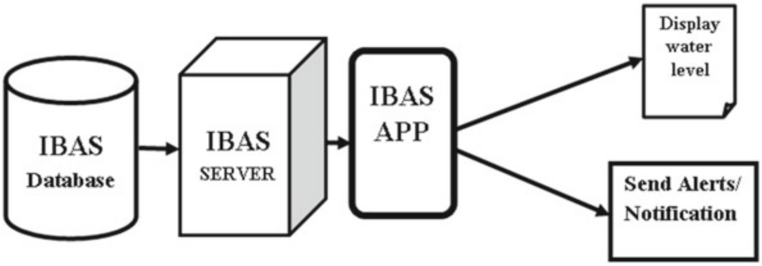

Fig. 3 IBAS mobile app workflow

4.2 IBAS App Module

IBAS App module serves as the instant query answering machine which takes data from the latest updated information on the server. Whenever the user opens mobile app it displays the information such as water level in graphical format. This also sends notifications and alerts when required such as situations arising due to low water level. This is shown in Fig. 3.

4.3 IOT Kit

Internet of Things is used to connect the things and transmit data to server. In IBAS, IOT collects the data from sensors and transmit data to server periodically [5]. This plays an important role in updating information online.

4.4 Water-Level Sensors

Different sensors such as Ultrasonic Sensors, Pressure Sensors, Radar Sensors, Open Channel Sensors, Capacitance Sensor, Submersible Hydrostatic Sensor, Magnetostrictive Sensor, Hydrostatic Sensor, Magnetic Float Level Sensor, Piezo Level Sensor, Piezoresistive Sensor, Leak Detection Sensor are being tested for accurate water-level detection. After working with all sensors Capacitance and Hydrostatic Sensors are found to be accurate in tracing the water levels and cost-effective.

4.5 Test Results

The IBAS system is developed and tested and found to be accurate compared to manual systems. The confusion matrix is as shown in Fig. 4.

n=200	Yes (Predicted)	No (Predicted)	
Yes (Actual)	130(TP)	7(FN)	137
No (Actual)	5(FP)	58(TN)	63
	135	65	

Fig. 4 IBAS confusion matrix

The confusion matrix shown in Fig. 4 is obtained by noting the values after running the IBAS system for 200 times denoted by n. The accuracy is calculated by using the formula shown in Eq. (1)

$$\text{Acc} = (\text{TP} + \text{TN})/(\text{TP} + \text{TN} + \text{FP} + \text{FN}). \qquad (1)$$

where Acc is the accuracy, TP is True Positive, TN is True Negative, FP is False Positive and FN is False Negative Value. Here the Acc is calculated as

$$\text{Acc} = (130 + 58)/(130 + 58 + 5 + 7) = 0.94.$$

5 Conclusion

The proposed system is implemented for detecting electronic water-level indicator including borewell starter. The automated system helps in eradicating wastage of water and informs borewell water levels periodically to consumer. This starts pump when water-level drops below a certain level and stops when it reaches maximum level. Easy to install and operate, it gives trouble-free service for longer periods. The system keeps the entire system safe. This can be used for geological survey for checking well depths for checking well safety. This can be used in new construction projects.

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