Research Article

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Water Management System by Global Service Mobile (GSM) using Nanostructured Magnesium Oxide as Display for Agriculture Purposes

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ABSTRACT

Herein we investigate the nanostructured MgO as an important material used for developing a water management system. In this prototype, the various technologies available in the market for short message services (SMS) based canal pipeline water management using MgO nanoparticles as display devices are explored for agriculture purposes. We motivate our research and provide a conceptual introduction that illustrates the need to increase or decrease the level of water by activating three different water gates represented by the water pump. If there is a need to increase the level of water, we can do, decrease the level then also we can do by two different SMS. Subsequently, we suggest general system architecture for this mobile-based irrigation system for agriculture application for farmers and discuss related design and decision. This design has been implemented as a prototype which we named "Water management system (WMS) by global service mobile (GSM) using nanostructured MgO as display" for agriculture purposes.

Keywords: MgO Nanoparticles; Global Service Mobile (GSM); Water Management Systems (WMS); Agriculture; Relays.

1. INTRODUCTION

A GSM technology for a water management system is proposed. As a first step towards a solution, we take the user's perspective for water-saving and time management which can be deployed on the basic mobile handset device. Subsequently, we suggest general system architecture for this mobile-based horticulture system application for a farmer and discuss related design decision which helps farmers to determine how much water their plant to use and how long they need to run their pump or drip their system for each day using the GSM based technology and mobile phone-based delivery services. The objective of this prototype is to develop a device that allows the user to remotely control and monitor multiple water level management for different gardens using a cellular GSM phone. This system will be a powerful and flexible tool that will offer this service at any time, by anybody and anywhere, without the constraints of the technologies being applied. The wireless device has been gaining popularity in recent years. Cellular phones and other wireless devices have driven demand for new wireless technology. In this regard, nanostructured magnesium oxide has been used as an efficient optical material to use as a display for various reasons as metal oxides play a very important role in many areas of electronics, physics, chemistry, and materials science, for different applications (Gangwar *et al.* 2016). These can adopt a large number of structural geometries with a proper electronic structure that can exhibit metallic, semiconductor, or insulator character. The optical properties of magnesium oxide (MgO) widely study both experimentally and theoretically due to the presence of defects (Jain *et al.* 2016) at the surface sites and their large bandgap. Thus it gains significant attention among various research group in this area and become a huge research topic (Peter *et al.* 2015).

The objective of this project is to develop a device that allows the user to remotely control and monitor multiple water level management for different gardens using a cellular GSM phone. Fig. 1 shows the basic block diagram of our purposed prototype. This prototype is about the technique of wireless sensor, which is used to make irrigation system better for water management by SMS approach and helps irrigators to determine how much water their crop has used (Xia *et al.* 2008) and how long they need to run their pump or drip system for each day using the latest in remote sensing wireless techniques and mobile phone-based delivery services.

Pan Team describes the importance of WSN in his research paper (Pan *et al.* 2010) and discusses the tremendous applications in data acquisition of the wireless sensor networks. The wireless device has been gaining popularity in recent years. Cellular phones and other wireless devices have driven demand for new wireless technology. While traditional wired solutions provide a sense of reliability, convenience has become a large part of consumer's needs. The information below is factual and provides a non-biased evaluation of current wired and wireless technology in water management system application. The purpose of this study is to review contemporary wireless network protocols and areas that affect the ability of wireless fidelity (Wi-Fi) technology to secure data transmitted over wireless networks (Fang *et al.* 2009). The research approach takes the form of a case study; in collating the methods used by existing protocols in the implementation of wireless security. So far, researchers have acknowledged that location privacy is critical to the security of data transmitted by wireless technology.

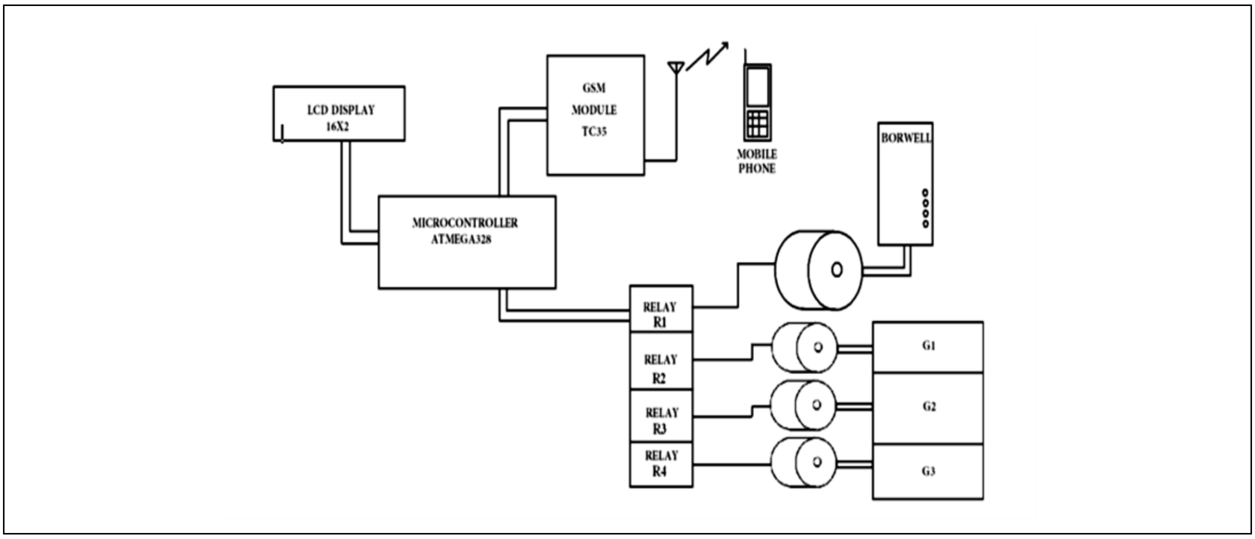

Fig. 1: Basic block diagram of water management system using nanostructured magnesium oxide.

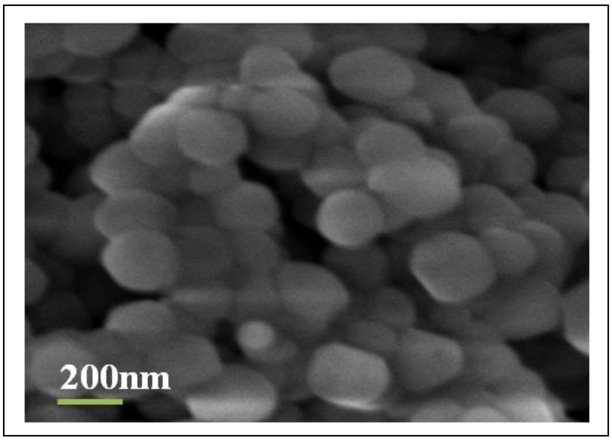

Fig. 2: Electron microscopy image of magnesium oxide nanoparticles.

2. SYNTHESIS OF MgO NANOSTRUCTURE

MgO nanostructures were obtained via hydrothermal method initially magnesium chloride ($MgCl_2$) (5.3 g, Sigma Chemical Co.) is added in 50 ml deionized water. Now add 2.03g of sodium hydroxide to 10 ml deionized water. Then add wisely NaOH dropwise to the solution at 50 °C for 2h to get white precipitates. The obtained white precipitate was put into an autoclave at 250°C temperature for 10 h to get $Mg(OH)_2$. Subsequently, as-synthesized $Mg(OH)_2$ is calcined at 500 °C for obtaining MgO nanostructures, and these nanostructures are used for display. Fig.2 shows an illustrative example of an electron microscopy image of MgO nanoparticles which has been used as a display.

3. COATING OF MgO (FILM PREPARATION)

The obtained MgO nanostructures were then added drop-wise to the glass substrate for building a film by using a single dip coater (Apex Instrument Company), and for getting uniformity of the film, we use a spin coating unit SCU-2007 (Apex Instrument Company) with some vacuum pressure. Finally, a film with the green color coating is prepared as a display unit for the execution of our prototype, as shown in fig. 3.

Fig. 3. Shows the proposed prototype of our system. This system can help water resources managers to appreciate the potential of remote sensing capabilities for application. The available surface and groundwater resources are inadequate to meet the entire water requirement for the all-purpose because the demand for water has increased in recent years. It needs the assessment of quantity and quality of water for its optional utilization.

The survey will be beneficial in the development of a new and comprehensive irrigation control system with many advantages for resource management (Liu *et al.* 2007). Existing irrigation control technologies having many deficiencies have been compared and referenced. Many models have been compared with our proposed model that is cost-effective, and contains many other characteristics. A Wireless Sensor and Actuator Network (WSAN) is a group of sensors and actuators linked by wireless medium to perform distributed sensing and actuating tasks. Wireless sensor network technology (WSN) is an efficient method that provides dynamic, real-time observation for distributed data collection and monitoring (Li *et al.* 2010).

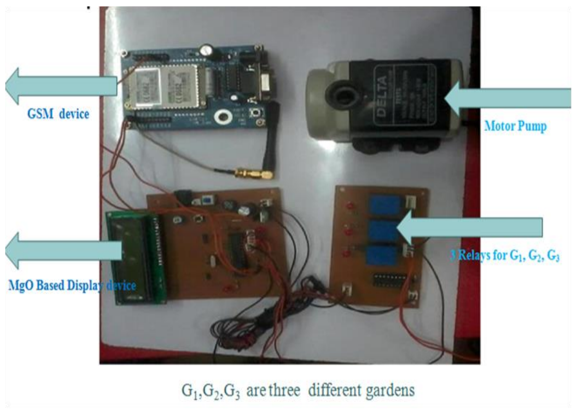

Fig. 3: Prototype of the water management system, using nanostructured magnesium oxide.

Ali *et al.* (2010) discuss cost-effective irrigation control using the WSN framework for monitoring the environment in greenhouses. He proposed how to design, deploy and test a framework for wireless sensor networks using WSN for monitoring the environment in agriculture. Its main advantage is proposing an inexpensive solution for wirelessly monitoring the agricultural fields and increasing the yield of crops. He has also presented a comparison of the available motes in the market. There are many challenges in the domain of agriculture like climate change, water shortage, labor shortage, societal concerns, etc. Cattle farming that also very much dependent on the agriculture domain, has some other issues like animal welfare, food safety, and environmental effects, etc.

Liu *et al.* (2007) created a remote measurement and control system for Green House based on GSM-SMS and the pastures evaluation. Their work includes the development of solar-powered special sensors, sensor networks for pastures, Soil moister assessment and photographic analysis of grass growth, and the sensor network for animal behavior (sleeping, grazing, ruminating, etc.) analysis and control. Arrouf *et al.* (2011) Photovoltaic pumping system based on Intel controller.

4. RESULT & DISCUSSION

This prototype is to develop a device that allows the user to remotely control and monitor multiple water level management for different gardens using a cellular GSM phone, as shown in Table 1. This system will be a powerful and flexible tool. Moreover, the same prototype is also tested for money plant (placed in 250 ml of water jar as shown in fig. 4) for checking the water level requirement on a daily basis as indicated in Table 2 that will offer this service at any time, by anybody and anywhere without the constraints of the technologies being applied. The circuit is also tested for switching ON and OFF for filling the water tank. The circuit is working fine, and found that the motor is automatically ON and OFF based on the level of the water level as shown in table 1. Moreover, table 2 indicates the water requirement by a money plant on a daily basis. From the above observations, as indicated in Table 2, the amount of water required by the money plant placed in a water jar is approximately equal to 0.002058 ml/per day (the same digit is also displayed by the prototype). However, the same prototype is also fully tested and demonstrated at Water Technology Center (WTC) in Indian Agriculture and Research Institute (IARI) Pusa, New Delhi, during the training program held from 19th to 24th December 2016. Moreover, on dated 24th December 2016, the prototype is interfaced with an embedded circuit board containing inbuilt global service mobile (GSM module) placed inside a cultivated land (Field) having three different varieties of crops for testing the module as a display and determination of water level at each crop. Fig.4 shown below, indicates the implementation and real-time testing of the prototype.

Fig. 4: Testing of prototype and water requirement by a money plant placed in 250 ml of the water jar.

Table 1. Indicate the testing of prototype and water requirement in three different gardens.

Test Case	Description	Expected Result	Actual Result
1	Automatic Water Supply ON for Garden 1	Water Flow Through Pipe 1 only	Yes
2	Automatic Water Supply ON for Garden 2	Water Flow Through Pipe 2 only	Yes
3	Automatic Water Supply ON for Garden 3	Water Flow Through Pipe 3 only	Yes
4	Automatic Water Supply ON for Garden 1 and 2	Water Flow Through Pipe 1 & 2 only	Yes
5	Automatic Water Supply ON for Garden 1and 3	Water Flow Through Pipe 1 & 3 only	Yes
6	Automatic Water Supply ON for Garden 2 and 3	Water Flow Through Pipe 2&3 only	Yes
7	Automatic Water Supply ON for Garden 1,2 and 3	Water Flow Through all Pipes	Yes

Table 2. Indicate the testing of prototype and water requirement by a money plant.

No. of Days	The plant used for testing by the Prototype	Amount of water requirement (ml)
Day 1	Money Plant	0.00205 ml
Day 2	Money Plant	0.00207 ml
Day 3	Money Plant	0.00205 ml
Day 4	Money Plant	0.00204 ml
Day 5	Money Plant	0.00206 ml
Day 6	Money Plant	0.00205 ml
Day 7	Money Plant	0.00205 ml
Day 8	Money Plant	0.00206 ml
Day 9	Money Plant	0.00207 ml
Day 10	Money Plant	0.00208 ml

Fig. 5: Testing of prototype and water requirement by different crops in a cultivated land (a) Pulse (b) Maize and (c) wheat.

4. CONCLUSION

The idea behind this prototype is to use the existing wireless sensor infrastructure and all the operations involving the GSM system. Further, we send a short message service (SMS), which goes through the GSM system which can be used as a simple SIM card and GSM module. To operate a GSM modem, we have to use the AT commands to operate them. For example, if an SMS arrives the GSM modem sends the serial data in ASCII format, then we read this data and if we connect the modem with the serial port of the microcontroller (89CS51) at the baud rate of data flow is 9600(BR) which can turn on/off any pump by sending a proper message hence we can always control the water level of different gardens, water level in a money plant and water requirement in a cultivated land (agriculture purposes). Table 1 shows the automatic supply of water from3 different gardens G_1, G_2, and G_3. As the microcontroller comes to know that an SMS has arrived, it can send a proper AT command to read the SMS. The reading of the message returns the mobile no of the sender, the time, and much more information. We have to select the SMS part of the message. The starting string of the SMS is used as the password. As the password is matched, then the same message that has arrived is assumed to be valid by the microcontroller; otherwise, it ignores the same message. Here the starting character is the '#,' and the terminating character is '*.' To control the water supply, here we have used three water pumps. Additionally, we can read the water level also by sending a proper message to the system. Table 2 indicates the water requirement by a money plant on a daily basis. Hence in general, the possible target includes water systems, security systems, solid-state electronic devices, the management system in agriculture/horticulture purposes, and climate control anything with an electrical interface.

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CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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