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IOT BASED AUTOMATIC MANHOLE COVER CONTROLLING MECHANISM FOR SMART CITIES

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***Abstract**: The main objective of the thesis is to analyze the damages caused in our region due to floods. This natural disaster has caused many people to suffer damage to their homes and losing their belongings. There exist encouragements for researching preliminary solutions in this kind of disaster to mitigate and help in rescue operations. A variety of options there is for creating systems capable of warning vulnerable populations about an imminent threat of floods. It is important to understand deficiencies in methods and processes for measuring water level in rivers. However, the above brings deficiency in the measurement process because the data may not have been accurately captured and brought to where this information could be too late for help or planning a rescue strategy. The fact that the data collection of levels of water bodies is executed by a person and it carries dangers and delays in the dissemination of information. One of these risks is endangering the person who comes to take action, as torrential rains access to the measuring points are extremely complicated, and in cases of possible flooding these delays are crucial to salvaging belongings and especially the lives of people living in areas at risk. Because of the expensive cost of gauges to measure water level and the importance of developing warning systems for measuring levels in rivers that contribute to safeguard lives of citizens who inhabit regions in danger of flooding, we present a water level sensor based on water conductivity. Along with floods we are going to alert the people about earthquake.*

A new solution is provided for the traditional sensor data acquisitions. Performance of the proposed system is verified and good effects are achieved in practical application of IoT to water environment monitoring.

Keywords: Raspberry Pi3 Board (ARM11), GPS Module, Earthquake Detector, Water level Sensor, IoT Environment, Status LEDs, Siren, Raspbian OS(Linux) QT Creator.

1. INTRODUCTION

Very recently it appeared the concept of Internet of Things (IoT) as a topic emerged in the wireless technology field. IoT describes the pervasive presence of a variety of devices such as sensors, actuators, and smart phones or mobile phones that through unique addressing schemes are able to interact and cooperate with each other to reach common goals. In is mentioned Internet of Things is a paradigm as a result of the convergence of three different visions: Internet-oriented visions (middleware), things oriented (sensors) visions and semantic-oriented (knowledge) visions. In previous works dealing with this term. Hence, it is possible to use the concept of IoT to provide communication capabilities to a device that could alert opportunely to a population before a natural disaster occurs.

Before using sensors integrated into IoT (”Things”-oriented vision) some works have been proposed to disaster situations. Specifically “Things”-oriented vision works like where RFID technology is used. However, we are especially interested in those applications centered in disasters by floods. For example, a system for flood detection is ALERT.

With rapid development of IoT, major manufacturers are dedicated to the research of multisensory acquisition interface equipment. There are a lot of data acquisition multiple-interface equipments with mature technologies on the market. But these interface devices are very specialized in working style, so they are not individually adaptable to the changing IoT environment. Meanwhile, these universal data acquisition interfaces are often restricted in physical properties of sensors (the connect number, sampling rate, and signal types). Now, micro control unit (MCU) is used as the core controller in mainstream data acquisition interface device. MCU has the advantage of low price and low power consumption, which makes it relatively easy to implement. But, it performs a task by way of interrupt, which makes these multisensory acquisition interfaces not really parallel in collecting multisensory data.

On the other hand, ARM family has unique hardware logic control, real-time performance, and synchronicity which enable it to achieve parallel acquisition of multi sensor data and greatly improve real-time performance of the system. Raspberri Pi board has currently becomes more popular than MCU in multi sensor data acquisition in IoT environment. However, in IoT environment, different industrial WSNs involve a lot of complex and diverse sensors. At the same time, each sensor has its own requirements for readout and different users have their own applications that require different types of sensors. It leads to the necessity of writing complex and cumbersome sensor driver code and data collection procedures for every sensor newly connected to interface device, which brings many challenges to the researches.

The rest of this paper is organized as follows. The architecture is presented in Section II, and detailed hardware and software implementations are described in Section III. Project Implementation methodology in Section IV. Finally, we conclude our work with results in Section V.

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II.SYSTEM ARCHITECTURE

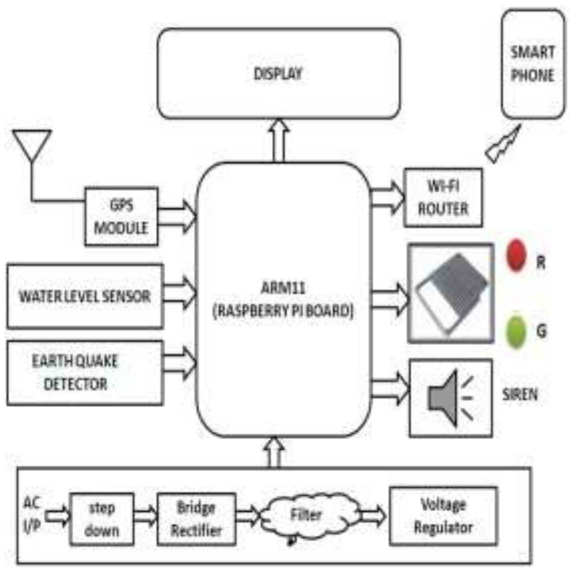

Figure.1 System block diagram

The most important step in the design and development of the IOT based floods alerting system and earthquake safety enhancement is presented. The proposed system consists of modules & technology, ARM11 (Raspberry PI-3 Model B) controller. These devices are low cost, more efficient and capable of processing, analyzing, sending and viewing the data on cloud and also through wireless communication (Wi-Fi) device in smart phones. This can implement is suitable for environment. This support can be obtained from book or from websites. Before building the system the above consideration are taken into account for developing the proposed system.

We program IP core module of IEEE1451.2 corresponding protocol in its Pi board. Therefore, our interface device can automatically discover sensors connected to it, and to collect multiple sets of sensor data intelligently, and parallel with high-speed.

III.HARDWARE IMPLEMENTATION

3.1. Raspberry Pi Board

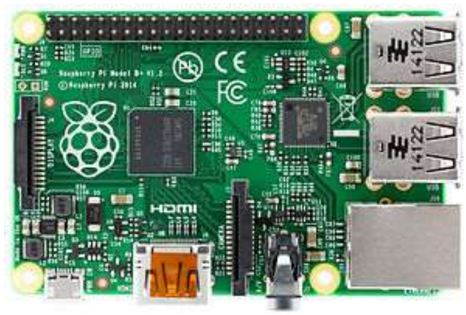

Figure 2: Raspberry Pi3 Board

Raspberry Pi3 (shown in Fig. 2) board has 1GB RAM, 4 USB ports and an Ethernet port. It has a Broadcom BCM2837 system on a chip which includes an ARMl176JZF-S 700 MHz processor, Video Core IV GPU, and an SD card. The GPU is capable of Blu-ray quality playback, using H.264 at 40MBits/s. It has a fast 3D core accessed using the supplied OpenGL ES2.0 and Open VG libraries. The chip specifically provides HDMI and there is no VGA support. This includes but is not limited to education tools, especially the use of GPIO (General Purpose Input/Output) which allows automated data acquisition and producing simple digital control systems in a school laboratory setting. The most distinctive feature of the Raspberry Pi when used for educational purposes is the GPIO module, which allows interfacing with general purpose electronics.

3.2. GPS Technology

The Global Positioning System (GPS) is a satellite based navigation system that sends and receives radio signals. A GPS receiver acquires these signals and provides the user with information. Using GPS technology, one can determine location, velocity and time, 24 hours a day, in any weather conditions anywhere in the world for free.

GPS was formally known as the NAVSTAR (Navigation Satellite Timing and Ranging). Global Positioning System was originally developed for military. Because of its popular navigation capabilities and because GPS technology can be accessed using small, inexpensive equipment, the government made the system available for civilian use. The USA owns GPS technology and the Department of Defence maintains it.

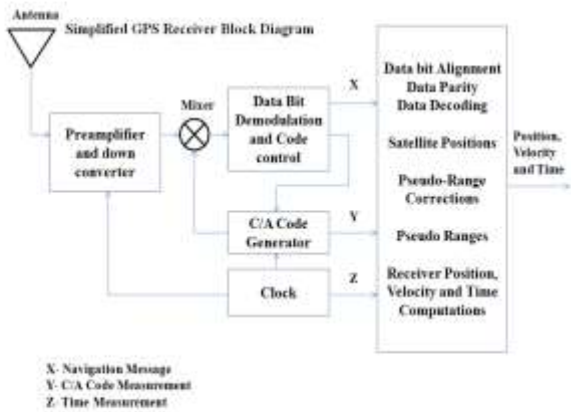

Fig 3. GPS Receiver Block Diagram

3.3 IOT Application Gateway

The ARM11 is connected to a router with a wired serial connection. The router runs open source embedded Linux software, providing networking functionality to connect the internet. This essentially provides internet access to the ARM11 board. Router acts as an IoT application gateway and interconnects. A private IPv6 network using a Virtual Private Network (VPN) is used for connecting the IoT application gateway to the server.

The server collects sensor data forwarded by the application gateway and store in a database for further processing and then to be viewed via a website. Data can be viewed in terms of previous day, week, and month time periods graphically. In the present setup, heterogeneous sensing units are designed and developed indigenously for intelligent home monitoring systems to integrate with IoT networks.

Figure 4: Internet Router

The Linux-Open WRT software provides the networking architecture to participate in many types of networks. These networks are abstracted into devices, which generalizes management and configuration. This abstraction requires device drivers which operate in the kernel space, making development difficult. A TUN/TAP device driver acts as a virtual network device with its output directed to a user space program instead of a physical device. This simplifies the development of a network device, as a user space program is easier to develop

3.4 Water Level Sensor Characteristics:

This simple transistor based water level indicator circuit is very useful to indicate the water levels. Whenever manhole gets filled, we get alerts on particular levels. Here we have created 2 levels (low, high), we can create alarms for more levels. We have added 2 LEDs to indicate initial two levels (A, B), and one Buzzer to indicate FULL level.

When manhole gets filled completely we get beep sound from Buzzer and manhole cover will get controlled.

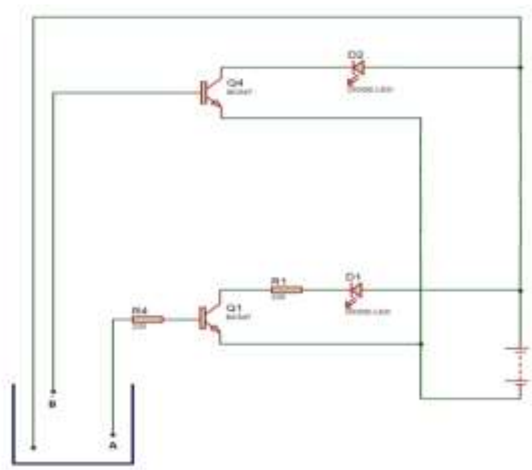

Figure 5: Water Level Sensor

EARTHQUAKE DETECTOR (Model-KG180):

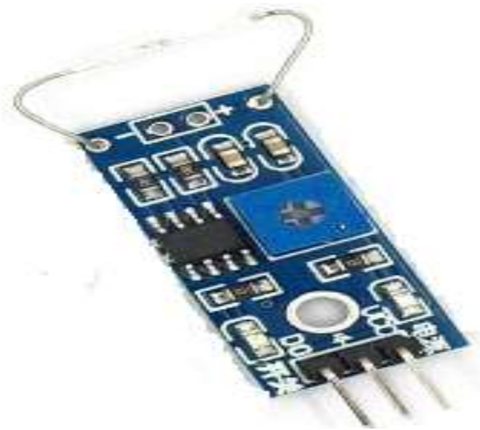

Figure 6: Ultrasensitive Earthquake sensor

Here is an ultra sensitive earthquake detector circuit that can sense seismic vibrations. It can be used to detect vibrations in the Earth. So it is an ideal device to monitor entry passages. The circuit exploits the direct piezo electric property of the piezo element used in buzzers. The Lead Zirconate crystals present in the piezoelement can readily store current and can release the current when the orientations of the crystals are disturbed through mechanical vibrations. VR adjusts the sensitivity of piezo element. Glue the fine side of the piezo element on the floor (if used as an entry alarm) or inside a metal box (if used to bury in soil to detect earth borne vibrations).

IV IMPLEMENTATION METHODOLY

This micro-model was implemented based on highly a programmable electronic board (ARM11-Raspberry PI-3 Model-B), where some electrical resistors were connected to three heights into a water container, the rising water levels covering the resistance so that cause variation in the impedance, this fact indicates what is the water level, and so on for the two different heights and also controls the respected action based on the level of water. This information was transmitted to a web server via inbuilt Wi-Fi communication. After, this information can be accessed by mobile devices and in website server users can graphically see the data, these data show the values of water levels. Subsequently, the prototype tests were conducted into a controlled environment, these tests consisted in measuring the water level in a container with water, different filling levels were tested, and such testing showed the expected results. And also Earthquake detection through which we can give pre-indication to the people. Given these facts, if it is known the time when raising the water level up to the threshold while the water level passes each level mark, it is possible to know exactly these calculations in a real scenario like a river. Hence, manhole cover can be controlled based on the level of water means it will be opened when cutoff level has crossed and it will be closed when the water level reaches to normal level, so inhabitants can make a decision and start preparing to evacuate their homes if necessary. So now we can consider a really warning system to alert residents of low-lying areas about changes in rivers.

V.EXPERIMENTAL RESULTS

The developed system is tested by installing the Smart sensing units and setting up an IOT based system. Interconnecting IPv6 network is performed by connecting and configuring the modified router (IoT application gateway) as discussed in section III. Integrated system was continuously used and updated real-time sensing information to the server over an IOT environment.

The pictorial representation observed as shown below: Fig. 7(a, b, c, d) shows the type # 1 sensing unit information in real-time on the IoT website.

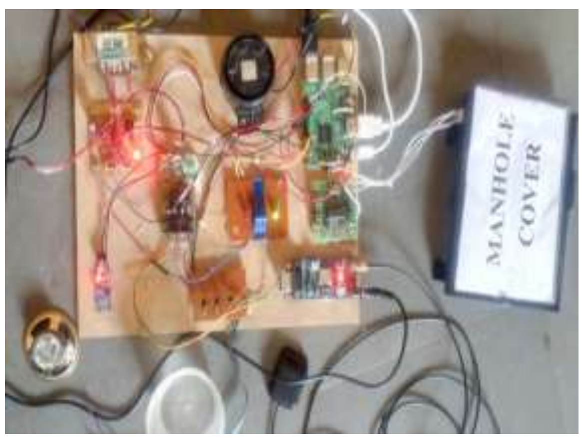

Figure7 (a): Hardware setup

Figure 7(b): Manhole cover opened when water level crossed the cutoff level

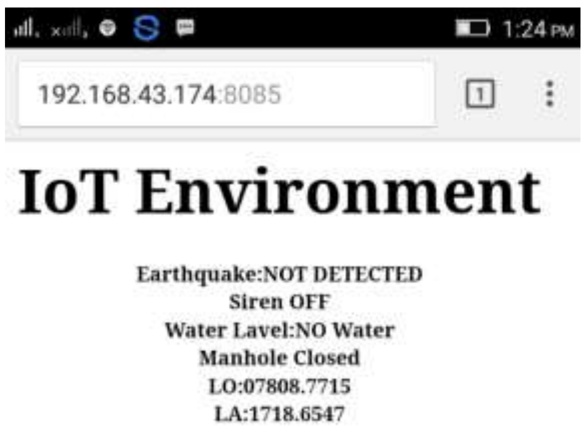

Figure 7(c): Initial sensor data uploading to server

Figure 7(d): captured sensor values on web page

According to Figures shown below 7(a) is an initial hardware prototype. Figure 7(b), shows manhole cover opened when flow of water level detected high. Figure 7(c) shows that the initial status of manhole covers on the webpage. Figure 7(d) shows webpage when abnormal condition of water level detected .

VI.CONCLUSION

This paper describes how an IoT based flood alerting system using raspberry pi board has been successfully designed and tested.

Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented. According to definitions of IoT, if we consider a sensor as an element of IoT which enables to communicate its current status and be published on Internet, then our proposal is very close to what we are intending to achieve within the concept of Internet of things.

It is very suitable for real-time and effective requirements of the high-speed data acquisition system in IoT environment. The application of ARM11 greatly simplifies the design of peripheral circuit, and makes the whole system more flexible and extensible. Finally, by taking real-time monitoring of water environment in IoT environment as an example, we verified that the system achieved good effects in practical application.

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