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Raspberry Pi based automatic meter reading

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ABSTRACT

In recent years,most developed countries like the United States and other European countries used automated meter reading systems (AMR). These are more accurate measuring device than the conventional electromechanical meter reading system. This paper presents an implementation methodology for a wireless automatic meter reading system (WAMRS) incorporating the widely used GSM network. In many countries GSM and GPRS network is widely known for its vast coverage area, cost effectiveness and also for its competitive ever growing market. Processing flow is as camera capture the image, captured image is pre -processed to get display plate and characters are recognized by processor raspberry pi using contour algorithm, by taking difference between two readings of consecutive months billing is done and send it to the consumer using GSM wireless technology.

Keywords:-AMR, Processor ,Character recognition,contour algorithm, wireless technology

1.INTRODUCTION

With improving capabilities of networking, automation and information technology, automatic meter reading systems and industrial sensor networks have been adapting various communication media for their purposes . In Poland wireless data collection is mainly established using Global System for Mobile Communication (GSM) and specialized services such as Circuit Switched Data (CSD) or General Packet Radio Service (GPRS). In most cases, this scenario means that one GSM reading device is attached to every energy meter. In case of using CSD, the meter is identified by its phone number. While working in GPRS, the device most commonly acts as a data server, so it is convenient to have a fixed IP address of each device. This is realized by using private Access Point Names (APNs).
Using separate GSM devices, with its own SIM card each, suits well industrial consumers due to their relatively small number in comparison with household consumers and their distribution over a very large area. In addition, the costs of GSM module and SIM card maintenance are insignificant within used energy costs. As for small consumer market, the costs of installation and maintenance of automatic meter infrastructure should be matched to actual energy usage. Having very well prospering GSM AMR (Automatic Meter Reading) systems, it is a very natural idea to divide the costs over a larger number of consumers grouped in districts, estates or blocks of flats and utilize smart grid concept . In this scenario one GSM device acts as a router or data collector for a number of meters identified by particular phone number or IP address. In some cases, when smart metering infrastructure is taken into account during area development and design stage, it is possible to connect energy meters with GSM module using wired technologies such as RS485 bus, current loop (CLO) or Local Area Network (LAN). However, in most cases if such solution is even possible, it generates significant costs related to integration with existing infrastructure. Local communication can also be easily realized using power line communication technology (PLC) .

PLC technology, especially based on FSK (Frequency Shift Keying) or BPSK (Binary Phase Shift Keying), is well known and widely used in many AMR systems but it suffers from very low data-rate (<2400 bps) and vulnerability to external environment. On the other hand, OFDM (Orthogonal Frequency Division Multiplexing) technologies are relatively expensive or range limited. Complex computation of number of channels simultaneously requires sophisticated processor requirements.

2.RELATED WORK

Automatic meter reading Systems (AMR) continuously observes the energy meter and sends data. This is detailed inpaper [1],Who has expand fully automatic energy meter having the potential of tracking remote area and energy meter control . Paper [2] (2007) introduced working template of system, made to express the success and efficiency of automatic meter reading, through GSM wireless technology. In [3] proposed system automatically reads the energy used and sends it to the service provider with the use of existing short messaging service (SMS). The data take from the energy meter is stored in the database server which is find at the electricity board station through SMS gate way for

further processing by station, provider further sends electricity bills either by emails, SMS or by post. An automatic meter reading system focus on the design of an energy meter executed with Zig-Bee wireless communication as in [4].Embedded energy meter is developed in which [6] extreme demand of energy of consumer will be specified in meterused by the consumer. After beating the extreme demand, the connection will automatically be lost by an embedded system introduce in the meter itself.

3.PROPOSED WORK

Proposed system uses camera to take automatic meter reading. For capturing image camera is placed in front of energymeter of house. To get digits separate out & to calculate the bill for the month processor isused withcontour algorithm. In this paper, Raspberry Pi is usedbecause it is a sort of minicomputer. We can't install Microsoft Windows on it as it uses a different kind of processor. But you can install several versions of the Linux operating system which feels very much like Windows. If we want to, we can use the Raspberry Pi to surf the internet, send an email and many more using a word processor. Easy to use but powerful, affordable and difficult to break, the Raspberry Pi is the perfect for pursuing computer scientists. After that this bill is send to the server wirelessly using GSM and display on LCD for user's reference.

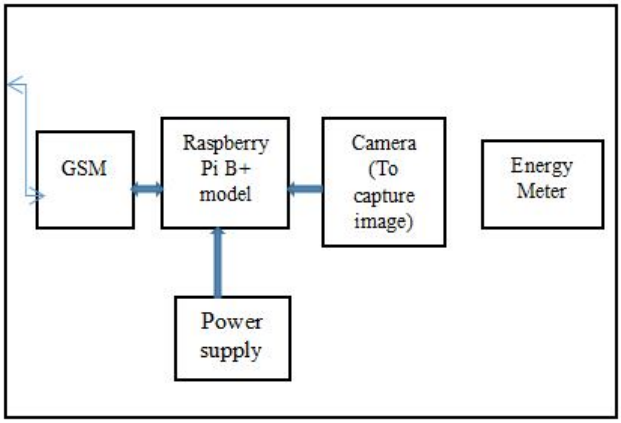

Fig 1. Block diagram at server side

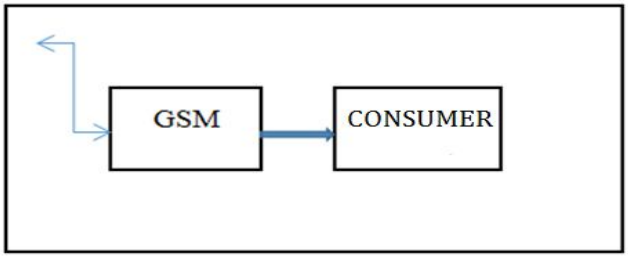

Fig 2: Block diagram at user side

As per definition of AMR, it allows easy saving through meter reading, greater data accuracy; improve billing speed and consumer service. Here camera is placed in front of E-meter as shown in fig 1. When command is send camera takes the photograph. This image is processed by raspberry pi using contour algorithm to calculate bill and send it using GSM.

3.3 Contour method

As per algorithm first take picture of meter using camera. Process this image with raspberry pi using contour algorithm. Contour algorithm works as follows,

The idea behind the square tracing algorithm is very simple; this could be attributed to the fact that the algorithm was one of the first attempts to extract the contour of a binary pattern.

Given a digital pattern i.e. a group of black pixels, on a background of white pixels i.e. a grid; locate a black pixel and declare it as your "**start**" pixel. (Locating a "**start**" pixel can be done in a number of ways; we'll start at the bottom left corner of the grid, scan each column of pixels from the bottom going upwards -starting from the leftmost column and proceeding to the right- until we encounter a black pixel. Declare that pixel as our "**start**" pixel.

Now, imagine that you are a bug (ladybird) standing on the start pixel as in fig below. In order to extract the contour of the pattern, you have to do the following:

every time you find yourself standing on a black pixel, turn left, and every time you find yourself standing on a white

pixel, turn right, until you encounter the startpixel again. The black pixels you walked over will be the contour of the pattern.

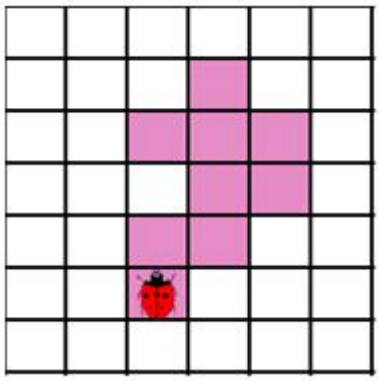

Fig 3: Sampled figure

The important thing in the square tracing algorithm is the "sense of direction". The left and right turns you make are with respect to your current positioning, which depends on the way you entered the pixel you are standing on. Therefore, it's important to keep track of your current orientation in order to make the right moves.

The following is a formal description of the square tracing algorithm:

Input: A square tessellation**, T,** containing a connected component **P** of black cells.

Output: A sequence **B (b_1, b_2 ,..., b_k)** of boundary pixels i.e. the contour.

Begin

- Set **B** to be empty.
- From bottom to top and left to right scan the cells of **T** until a black pixel, **s,** of **P** is found.
- Insert **s** in **B**.
- Set the current pixel, **p**, to be the starting pixel, **s**.
- Turn left i.e. visit the left adjacent pixel of **p**.
- Update **p** i.e. set it to be the current pixel.
- While **p** not equal to **s** do

If the current pixel **p** is black

- Insert **p** in **B** and turn left (visit the left adjacent pixel of **p**).
- Update **p** i.e. set it to be the current pixel.

else

- turn right (visit the right adjacent pixel of **p**).
- Update **p** i.e. set it to be the current pixel.

end

End

The Stopping Criterion:-

One weakness of the square tracing algorithm lies in the choice of the stopping criterion. In other words, when does the algorithm terminate?

In the original description of the square tracing algorithm, the stopping criterion is visiting the **start** pixel for a second time. It turns out that the algorithm will fail to contour trace a large family of patterns if it were to depend on that criterion.

As you can see, improving the stopping criterion would be a good start to improving the overall performance of the square tracing algorithm. There are 2 effective alternatives to the existing stopping criterion:a)Stop after visiting the start pixel *n* times, where n is at least 2, OR

b) Stop after entering the start pixel a second time in the same manner you entered it initially. This criterion was proposed by Jacob Eliosoff and we will therefore call it Jacob's stopping criterion. Changing the stopping criterion will generally improve the performance of the square tracing algorithm but will not allow it to overcome other weaknesses it has towards patterns of special kinds of connectivity.

Actual Implementation:

Fig 4: Actual Implementation

4.RESULT

Here is the comparison between the reading taking manually and by automatic meter reading system**.**

Table 1: Comparison between actual and AMR reading

	Reading type	Previous reading	Present reading	Unit difference	Calculated bill
1	Actual Reading	234.5	270.4	35.9	179.5
	Reading by AMR system	234.5	270.4	35.9	179.5
2	Actual Reading	242.6	260.3	17.7	88.5
	Reading by AMR system	242.8	260.3	17.5	87.5
3	Actual Reading	222.3	236.6	14.3	71.5
	Reading by AMR system	222.8	236.8	14	70
4	Actual Reading	238.1	276.6	38.5	192.5
	Reading	238.2	276.6	38.4	192

	by AMR system				
5	Actual Reading	228.4	238.7	10.3	51.5
	Reading by AMR system	228.4	238.8	10.4	52

From readings taken it is clear that there are faults in manual reading while capturing image and AMR system giving perfect reading as actual one. Hence the accuracy of AMR system is high and time required for calculations is also less.

5.CONCLUSION

In this paper with the help of presented proposed system it is possible to avoid meter reader visit and revisit (if there are any problems in billing) to each house to take reading. Also if consumer gets faulty bill he has to go to MSEB office to correct it and be in long queue. This is avoided here by taking photo of meter reading with camera located in front of meter and sending these readings to server wirelessly, keeping the database updated which is hard to maintain now a day's manually.
In future to reduce cost it may be possible to use single camera for each society or whole apartment energy meter room.

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