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Low Cost Foul detection and tracking System for Marathon Based on UHF RFID

Sharad Kakde, Gaurav Bhalekar, Krishna Patil, Warsha Kandlikar

National Institute of Electronics and Information Technology (NIELIT), Aurangabad (Maharashtra)

Abstract- **Marathon is one of the most popular and frequently conducted events across the world. For conducting this event huge man power is required for organizing the event, its successful conduction and declaration of the result. It is a tedious task for the organizers to verify all the participants at all the check points and to declare the result. Existing Solution is available but at very high cost. This paper presents observation, analysis and real time results obtained from foul detection and tracking system for marathon using UHF RFID. Ultra-high frequency (UHF) radio-frequency identification (RFID) reader is based on ARM CORTEX processor. Passive tags use a low power 4bit micro-controller with tag function implemented in assembly language routine[1].Our system decides a valid winner without human interference.**

Keywords: **DB9, Reader, RFDTS, RFID, RJ45, TCP/IP, UHF.**

I. INTRODUCTION

Radio frequency identification (RFID) is a non contact technology that means to automatically identify people and objects on the basis of radio waves. RFID is form of automatic identification technology (Auto ID) [2]. Auto ID means data which can be read by machine. Many technologies falls under this category but RFID have one advantage over other is that no need of line of sight. This is one of important reason for selecting this technology for our application.

For tracking one of the leading technologies is GPS but problem with that it is not real time basis which is key feature provided by RFDTS (RFID based foul detection and tracking system).For detection of large number of objects (human in our case) within short time suitable technologies are optical and RFID technology, but more suitable found RFID which can detect 100 tags/sec and more. Thus UHF RFID is used for this application.RFID is a technology in which reader radiates electromagnetic wave in air continuously whenever electronic tag (which hold unique id) comes in range of reader it sends data which is stored in its memory chip. Reader also known as interrogator which accepts data from electronic tag and send to desire port of reader which may DB9 or Ethernet (RJ45) or both depending on configuration setting of reader being used.

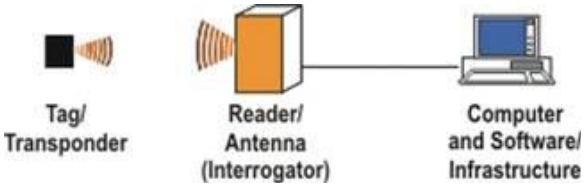

Fig1: System component of RFID technology [3]

Fig.1.0 shows the RFID system components. The antenna emits radio signals to activate the tag and at the same time read and write data to it. Antennas are the middleman in between the tag and the transceiver. It controls the system's data acquisition and communication [4]. The reader emits radio waves in ranges of anywhere from one inch to 100 feet or more, depending upon its power output and the radio frequency used. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer for processing [5].

II. PROJECT FLOW

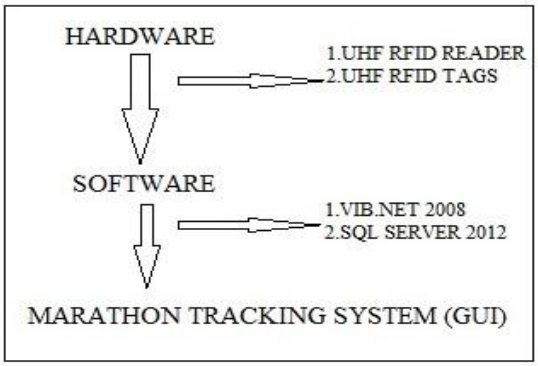

Fig 2: System development flow

III. HARDWARE

A. UHF RFID Reader

UHF RFID Reader, which detects tags and reads and writes information to/from the tags

B. UHF RFID Tag (T)

UHF RFID tag or transponder, which usually holds a Unique identification of each runner.

The system consists of UHF RFID Reader, Class1 Gen2 UHF Tags, application software and text/binary input and output files. The input files can be generated either by user interface or exporting form any type of data base in specified format. The out files can be imported to any type of database for further use like report generation etc. This makes the database independent. The reader is installed at each check point and connected to RFID server through RJ45 Port or Serial RS232 port. The reader keeps on emitting radio signals and generates a radio circle of 3 meters approximately. The RFID tag (chip) is assigned to each runner when runner pass through check point it sends data which is recorded into chip of tag.

The reader captures the radio signals, decodes it to a byte stream, and sends the information for further processing to the server. Server handles data stores into database by its check point identification.

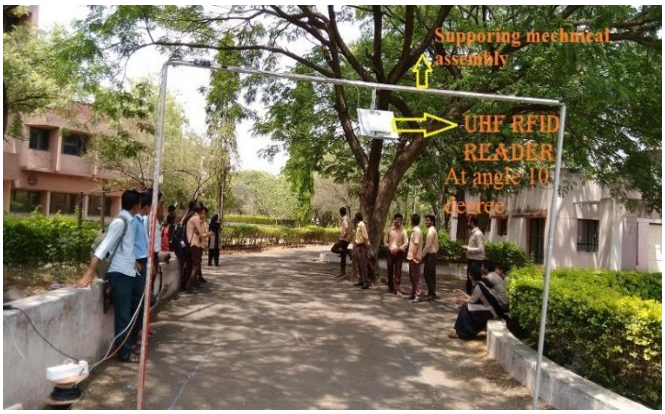

Fig 3: System Setup at Normal check point front view (Reader tilted at 10° with Horizontal Plane)

Fig 3.1: System Setup at Normal check point side view with effective area

IV. SOFTWARE

A. Application Interface Software (AIS)

AIS is the interface between Hardware (Reader) and RFID server.fig 4 shows flowchart of AIS

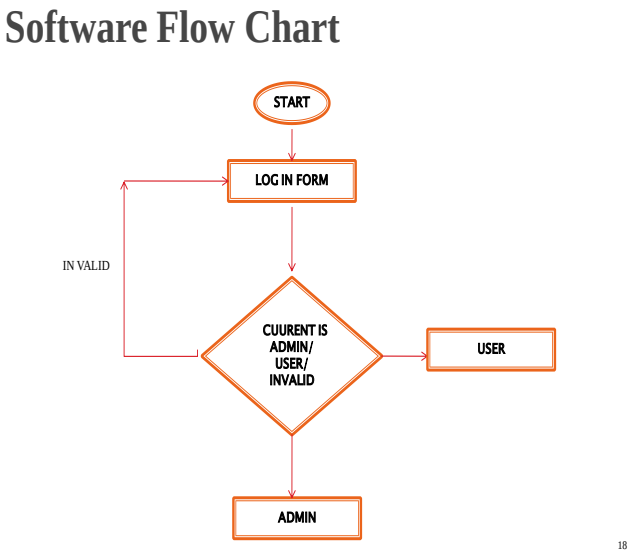

Fig 4: Software Flow Chart

B. RFID Server

This is main server which continuously monitors and collects data from Check Points (CP)

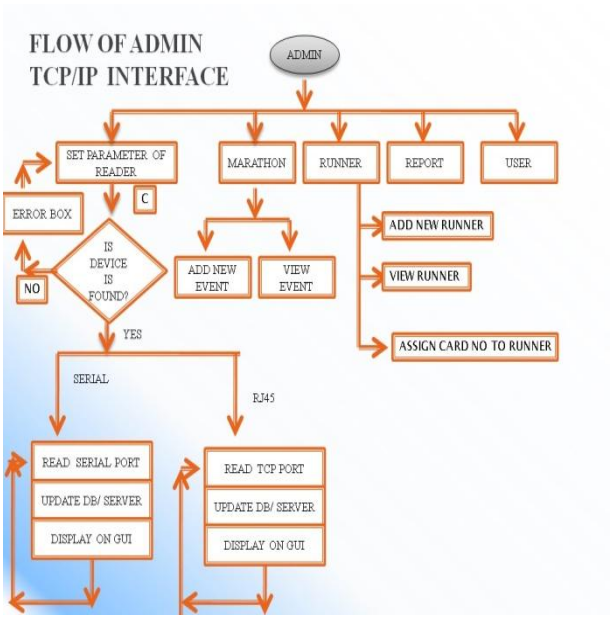

Fig 4.1: Flow Chart of Administrator

Above Fig Shows complete flowchart of Administrator GUI, in which background of each block is described in details.

V. WORKING

Marathon is one of the most popular and frequently conducted events across the world. Each Game has its own

set of rules, and if any participant violates any rule then the participant will automatically be disqualified by the system. Many times participants take shortcuts to win the marathon and this act will be caught and corrected by our system by eliminating such participants from the marathon. Every participant has to pass through each check point in order to complete his/her marathon. At each check point has our monitoring setup which continuously communicates with central RFID server.

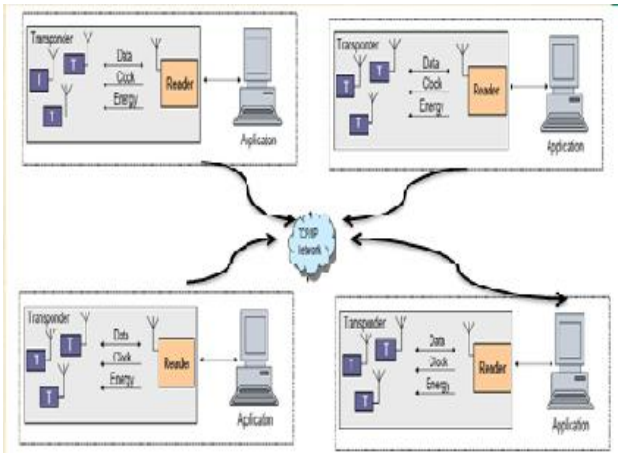

Fig 5: System block diagram

In fig 5 system transponder (T) is nothing but UHF tags carried by runner which holds its identity. C.P.1 (Check Point number 1) C.P.2 and C.P.3 are slave system of main RFID server enabled with client software with limited privileges like update server with real time runner data at that particular check point. At last (preferable) Master C.P. is there which have administrative rights to access database and can declare a winner with help of proposed algorithm.

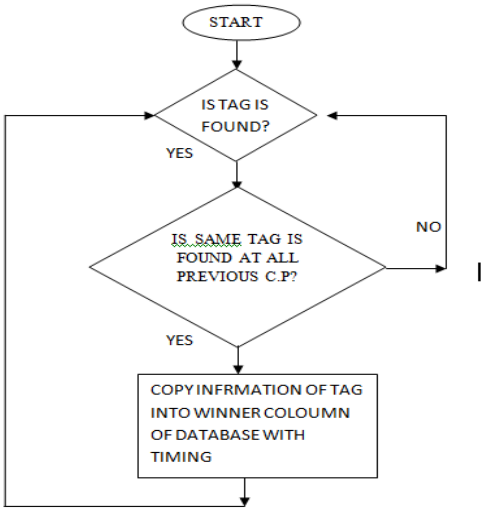

Fig5.1: winner selection algorithm.

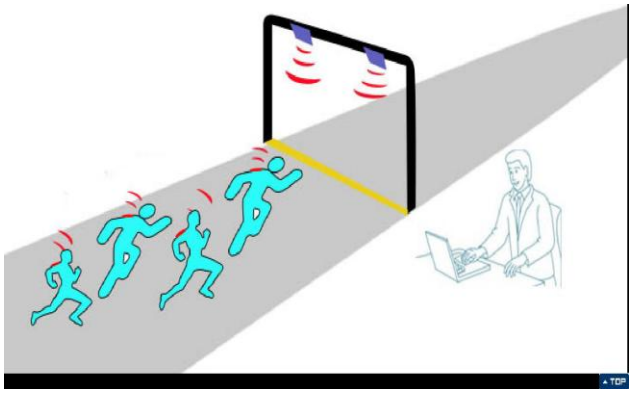

Fig 5.2 Setup at each checkpoint

The above fig shows setup at each check point which will continuously communicates with Main RFID server.

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VI. RESULTS AND EXPERIMENTAL ANALYSIS

Fig 6: Login Page

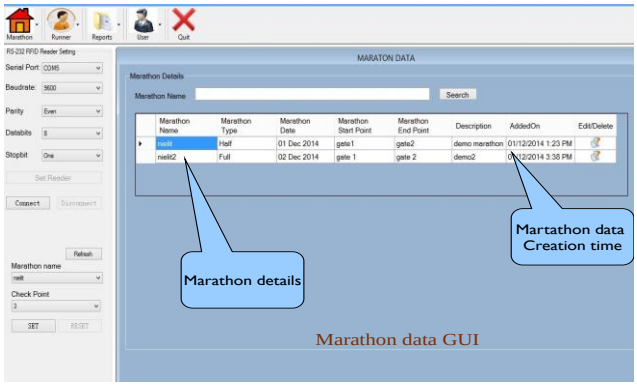

Fig 6.1: Marathon event details

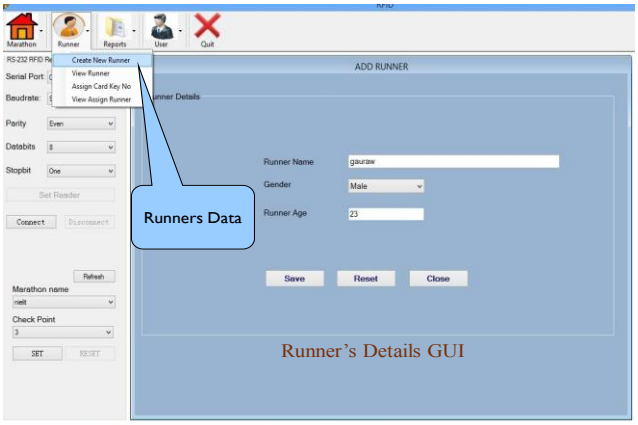

Fig 6.2: Runner registration.

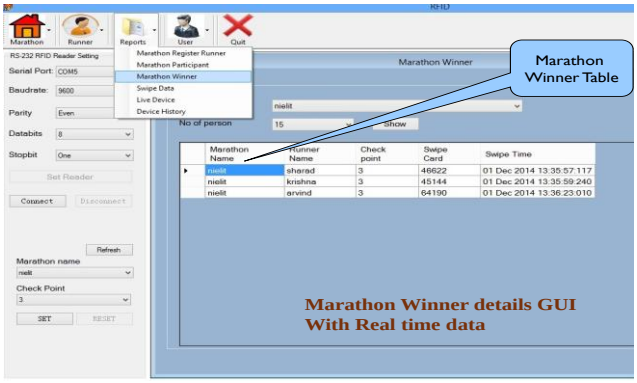

Fig 6.3: Report (Winner) of event by name of marathon

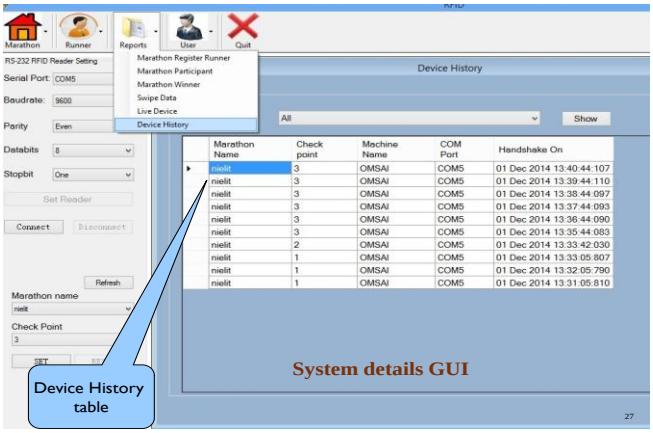

Fig 6.4: Device History connected to RFID server.

We experimented on 50 runners by conducting marathon and did an analysis in that we got 100 percent detection results at each check point by mounting our system.

Fig.6.5: It shows 1st to 4th experimental results at normal check point.

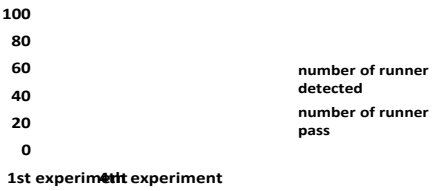

Fig.6.5: Chart For Normal Check Point (Except finish point)

Like this, same experimental result is analyzed for 50 observations.
We obtained success ratio (S.R) of 100%.

S.R = (Total runner passed in all experiment) / (Total runner detected by our system).

Fig6.6: shows accuracy at end check point (Finish line) for same number of experiments.

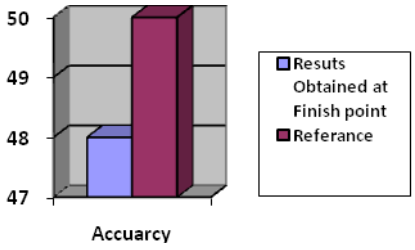

Fig6.6: Accuracy Chart for End Check Point (At Finish Line)

Accuracy = (Obtained result) /(Desired Result)
So we got percentage accuracy is 96%.

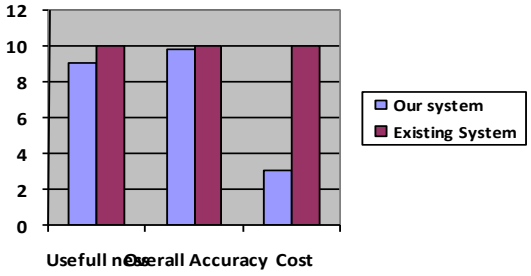

Fig 6.7: Comparison of Proposed system with Existing System.

Fig.6.7: Shows Comparison of existing system in market and our proposed system with refer to point usefulness,

overall accuracy and cost. We plot chat keeping reference point10, as we achieved too low concerning the existing system.

VII. CONCLUSION AND FUTURE SCOPE

In conclusion, objective to build low cost marathon tracking system is achieved with overall percentage accuracy of 98%. Also resolution of timing at finish line is order of millisecond (ms) which is quite good for marathon system. We interfaced RJ45 as well RS 232 port of UHF Reader with GUI successfully.

However as future scope little more modification can be done to get overall accuracy of 99.9%. We proposed to interface camera at end check point which will capture data only when runner is there in range of reader and with help of data generated by both reader and camera winner will be decided. This work will be published soon in our revised paper.

One more modification is development of GPRS enabled low cost RFID reader which makes system completely automatic.

ACKNOWLEDGMENT

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VIII. REFERENCES

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Authors

First Author

Sharad V.Kakde
Done B.Tech in E&TC from BAMU University
Pursuing MTech in Electronic Design Technology
From NIELIT Aurangabad.

Second Author

Bhalekar Gaurav Ramkrusha
Done BE in E&TC from BAMU University
Perusing MTech in Electronic Design Technology
From NIELIT Aurangabad.

Third Author

Patil Krishna Baburao
Done BE in E&TC from BAMU University
Pursuing MTech in Electronic Design Technology
From NIELIT Aurangabad.

Fourth Author

Mrs. Warsha Kandlikar

(Scientist C)

NIELIT Aurangabad.