

A Wearable RFID Device for Actual-Time Activity Reputation Using Radio Patterns

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ABSTRACT: So much work were completed in recreation realization utilizing wearable sensors equipped in a body sensor community. The quality and conversation reliability of the sensor knowledge so much affects the system efficiency. Recent reviews show the expertise of utilising RFID radio information as an alternative of sensor knowledge for endeavor cognizance. This process has the advantages of low cost and high reliability. Radio-based realization method is also amiable to packet loss and has the advantages including MAC layer simplicity and low transmission power stage. On this paper, we present a novel wearable Radio Frequency Identification (RFID) system using passive tags which might be smaller and more price-potent to respect human routine in actual-time. We make the most RFID radio patterns and extract both spatial and temporal elements to characterize more than a few routine. We additionally handle two issues - the false poor dilemma of tag readings and tag/antenna calibration, and design a rapid on-line recognition process.

KEYWORDS: Activity Recognition, Wearable RFID, Real-time

I. INTRODUCTION

With the rapid advances of wi-fi networking and sensing applied sciences in contemporary years, recognizing human exercise founded on wearable sensors has drawn so much research interest. On this paradigm, wearable sensors with sensing and wi-fi verbal exchange capabilities are equipped in a body sensor community (BSN) to capture distinct motion patterns of a person. Steady sensor readings are collected and processed at a centralized server for extracting valuable facets, training an suitable undertaking model, and recognizing a sort of movements. Recognizing persons as hobbies regularly in real-time enables a broad range of purposes, in particular in health monitoring, assistive living, rehabilitation, and amusement. At the same time BSNs have proven the effectiveness, they do have a few boundaries. First, the human body influences the nice of the wireless links between sensor nodes inflicting 2 Liang Wang et al. Packet loss . The day-to-day maintenance of the procedure (e.G., monitoring the remaining vigor and changing the batteries for multiple sensor nodes) is labor-intensive. Contemporary reviews exhibit that Radio Frequency Identification (RFID) applied sciences have the abilities to build inexpensive, riskless methods to become aware of particular routine similar to moving trajectories or gestures founded on radio knowledge . Prompted by means of these work, we discover the possibility of making use of extremely-excessive frequency (UHF) RFID method for difficult human undertaking cognizance.

Our approach is centered on two observations: 1) there exists heavy attenuation of the human physique to radio conversation band in which the UHF RFID operates, and 2) RFID radio common unique is totally littered with the tag antenna distance and orientation. Established on these observations, if we set up an RFID approach on a human body, user motions could outcome in specific radio patterns which is able to differentiate pursuits. In our process, packet loss and fading furnish priceless know-how for undertaking awareness

II. RELATED WORK

Much work were carried out founded on sensor readings for exercise consciousness. These sensing founded options . mostly install accelerometer sensors on a human body to seize physique motion. The sensor nodes are self-prepared

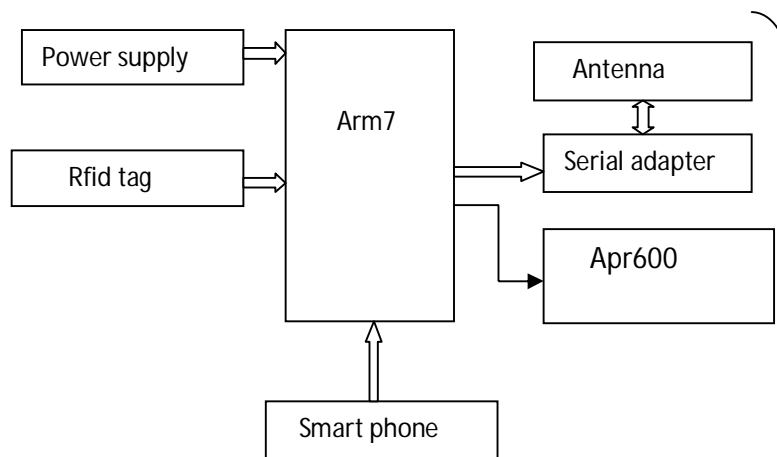
into a BSN the place right MAC and routing protocols are operated to make sure the quality of sensor knowledge. Distinct from these work, we take advantage of RFID radio information for endeavor awareness. RFID has been utilized in indoor localization and activity realization. For instance, fixed RFID readers and reference tags are deployed in the atmosphere with identified locations to monitor the cell tags or people using RSS values . In the authors use RFID for monitoring hand actions in a desk-size scale. The tags are positioned in a grid-like structure on a desk with readers placed at three corners. They use tag counting expertise received at extraordinary readers to keep track of hand actions. Distinct from the above work relying on constant RFID readers or tags for monitoring places or detecting easy relocating patterns, we design a wearable RFID system to recognize human routine involving problematic actions of unique physique ingredients always. Contemporary work have explored 2.4G RF radio information for activity realization.

Preliminary Experimental Studies:

In this section, we introduce our system hardware setup and conduct preliminary experiments to show the tag reading performance under different conditions and the potential of using radio patterns for activity recognition.

III. HARDWARE SETUP

- Serial to wifi adapter
- Rfid reader
- Antenna
- Smartphone
- Rfid tag
- Arm7



Wearable RFID Tags:

Much work has been done using BSNs for activity recognition, These BSN-based solutions usually deploy accelerometer sensors on a human body to capture body movements. The sensor nodes are self-organized into a BSN where appropriate MAC and routing protocols are operated to ensure the quality of sensor data. The advantage of BSNbased approaches lies in that they provide fine-grained activity recognition results with high coverage as the user wears the sensor as they move. While BSN-based approaches have shown their effectiveness, some limitations restrict them from being widely adopted for elderly care applications. The users need to correctly wear the sensors and avoiding issues caused by sensor displacement . Due to the sensor nodes are battery powered, constant maintenance to the system such as checking. Wearable rfid reader

gets stronger when the tag is placed closer to the antenna. Specifically, in the direction perpendicular to the antenna face, the tag can be stably read when placed within the distance of 60cm to 90cm.

Potential of Activity Recognition:

In this section, we demonstrate the potential of using RFID radio patterns extracted from RSS values for activity recognition. The experiment is carried out by one male subject performing three basic motions including standing, sitting, and walking. Four antennas and 36 tags are attached to the user as shown in Fig. 3(a) and introduced later in Section. During this experiment, we use the all antenna inventory mode of the reader which automatically activates the antennas for tag reading. Under this mode, the readings from the four antennas are mixed together. Also the four tags attached around the same body part share the same tag ID. The average RSS values of tags attached to different body parts .



From this figure, it is clear that different motions result in different RSS patterns. For the sitting activity, the RSS values of tags attached to the body, right leg left/right ankles are clearly stronger and more stable than other activities. For the standing activity, the RSS readings of the above mentioned body parts are also relatively more stable than the walking activity but the RSS values are lower than the sitting activity. Additionally, it can be seen from F that the RSS values of tags attached to the left wrist and left arm are stronger and more stable than other activities. For the walking activity, rhythmic variances in RSS values can be observed for tags attached to nearly every part of the human body, and they seem matched with arms and legs waving during the walking activity.

System Design:

The above preliminary studies have shown the feasibility and potential of using RFID radio patterns for activity recognition. In this section, we present the detailed design of the proposed RFID-based real-time activity recognition system including sensing, data segmentation, feature extraction and recognition algorithm.

Antenna / Tag Placement:

As suggested by Fig in our preliminary studies, we place four antennas on a human body – two antennas (one on the chest and the other on the back) for detecting hand/arm movements, and one antenna on each of the feet for detecting lower body movements . Such placement ensures a total coverage of different body parts, and also meet user's comfort need.

TAG PLACEMENT:

To capture the movement of different body parts, RFID tags are attached to nine body parts including both wrists, arms, ankles, legs, and the body. To increase the reliability of tag readings, we attach four tags at each body part. For example, for the right wrist, we attach four tag located at the front, left, right, and back of the wrist. This redundant tag placement strategy ensures that no matter how the user moves his/her wrist, at least one tag will face the antenna and

can be read by the reader with high probability. A total number of 36 tags are attached on the user's body with each tag having an unique ID.

ARM7:

The ARM7 TDMI-S processor also employs a distinct architectural technique known as Thumb, which makes it excellent to excessive-volume purposes with reminiscence restrictions, or applications the place code density is an limitation. The key concept behind Thumb is that of an excellent-reduced instruction set. Essentially, the ARM7 TDMI-S processor has two guideline units: The regular 32-bit ARM set, a 16-bit Thumb set .The Thumb set as sixteen-bit guideline size allows for it to strategy twice the density of regular ARM code while protecting most of the ARM as performance expertise over a common 16-bit processor making use of sixteen-bit registers. This is possible in view that Thumb code operates on the same 32-bit register set as ARM code. Thumb code is capable to furnish as much as sixty five % of the code dimension of ARM, and one hundred sixty % of the performance of an identical ARM processor linked to a sixteen-bit reminiscence method.

- ❖ ARM7 is a 32 bit microcontroller in a small LQFP64 bundle.
- ❖ It has 32kb on chip SRAM and 512kb on chip Flash memory.
- ❖ It has two IO ports each of 32 bit wide gave by 64 pins .
- ❖ It has single 10 bit ADC which gives variable simple yield.

IV. CONCLUSION

In this paper, we present a novel wearable RFID systems for real-time activity recognition. We implemented the prototype system, and the experiment results show our system achieves high accuracy and low delay. As our first prototype, there are some limitations. For example: 1) the current devices are a little cumbersome; 2) a large number of tags and antennas are used. In our future work, we plan to improve our system design by: 1) using smaller RFID readers, or smart phone integrated RFID readers; 2) studying more antenna and tag placement strategies and exploring the minimum number of tags and antennas necessary to achieve better system performance.

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