Intelligent Farm Relaxation for Smart City based on Internet of Things: Management System and Service Model

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Abstract: Farm relaxation is a type of city tourism. Currently, this type of tourism has demonstrated a series of problems, including blind spots in the service channel, simple one-sided service content and passive service delivery. To address these issues, here the concept of "intelligent farm relaxation" was proposed. In addition, an intelligent farm management system IEFMS was developed based on key techniques from the Internet of Things (IoT) as well as a related service model. This system has five layers, which are, from top to bottom: the presentation layer, the application layer, the application support layer, the data layer, and the infrastructure layer. Based on this, the intelligent farm was divided into four sections and a service model proposed: planting areas, a management services centre, a logistics distribution centre and a data centre. This service model is characterized by digital dynamic management and customized whole-process proactive services. The results of this study will help improve intelligent farm management services for smart city, likewise providing technical and application support for the intelligentization, automation and diversification of intelligent farm relaxation service management, and also to promote adding cultural, ecological, technological and service value to intelligent farm relaxation.

1 INTRODUCTION

In recent years, because of traffic congestion, air pollution, accelerated pace of living, and fierce competition, urbanites have strong demand for rural travel, in rural communities one can breathe cleaner atmosphere, feel closeness to nature, relax oneself, observe ecology and grow experience (Frochot I., 2005; Devesa M. et al., 2009; Vaugeois N. et al, 2015). Rural tourism plays an increasingly important role in cultural protection, economic development, increasing farmers' income and rural sustainable development (Jepson D. et al., 2015; Farmaki A. et al., 2012; Blezentis T. et al., 2012; Claire H.T. et al., 2012).

However, the applications of information technology in the aspect of rural tourism were far less than tourism industry or agriculture. There are still many problems in the following aspects:

- Service channels are not enough. On the face that farms are usually very large, it is difficult and time-consuming when providing service by traditional methods. Sometimes, it even has blind spots.
- Service contents are hard to get. There are a great many kinds of information in a farm, such as vegetables names, planting methods, edible methods, growth environment and so on. Generally, the above information is concerned but hard to get. Even asking the service staffs, the answer is usually simple, one-sided and lack of reasonable scientific reliability.
- Services are only provided in the passive methods. The service in farm comes from consumers' demands, such as information, purchase and entertainment. That means no demands, no service. This kind of service methods are passive, single, and lack of individuality and initiative service.

Therefore, how to provide personalized service more effectively and improve experience and degree of satisfaction becomes a key competitive point (Marzo-Navarro M. et al., 2015; Leask A., 2010; McBoyle G. et al., 2008). With high-speed inosculation and development of information technology, agriculture and tourism industry for smart city, it provides a feasible solution to offer accurate and convenient service by using the IoT technology and portable terminal devices. In this study, based on the IoT technologies, the

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management system and service mode is discussed, which organic combined agricultural and sideline products, agricultural technology, agricultural activities, arts and culture and consumer demand. It formed a benign interaction management and service system and created a new space for the development of leisure farm.

2 RELATED WORDS

'Intelligent farm relaxation' is a new solution to promote rural tourism development. It refers to integrating farm information resource, promoting information sharing and tourist services business collaboration, improving farm service efficiency and quality through the application of a new generation information technology. To be simple, it means the intellectualization for rural tourism industry.

Information technology was applied in the tourism industry started in 1952. At that time, tourists took shortwave radio receiver listening to the speech from the city museum (McCabe S. et al., 2012). In 2012, Lathia N., et al. presented that visitors could make better decisions by fast accessing and evaluating information according to their own needs if they got more information. And they established an Advanced Traveller Information Systems (ATIS) which provided user preferences analysis, schedule planning, environmental awareness, etc. using a variety of sensors through mobile phones. McCabe S., et al. (2012) studied the application of SBD (scenario-based design) technology in tourism, which provided a good tool for establishing communication among tourism stakeholders. Facing to the lacking of process management and information system as well as the ignoring of culture and ecological of Taiwan ocean tourism, Chen T.C. et al. (2012) implemented a marine tourism information system using process management, object-oriented analysis tools and the virtual reality panorama technology. And it improved the tourism industry profits and reduced the damage to the Marine environment.

In the field of agriculture production, information technology also played a huge role. For example, agricultural expert systems, knowledge systems, monitor systems, irrigation systems, elaborating systems, etc. And the IoT technology has a great potential in transportation, logistics, medical, environmental, personal and social areas. Based on this technology, planting environment monitoring (Zuo X.M. et al., 2011), management of supply chain for agricultural products (Verdouw C.N. et al., 2015), water-saving automation control (Dionisio Perez-Blanco C. et al., 2015; Zhang F., 2011), data management (Yu L.N. et al., 2011) and other related research has also been studied in agriculture field.

Yet, compared to agriculture and tourist industry, the researches and applications of information technologies in rural tourism have more deficiencies. With the integration of the development of agriculture and tourist industry, IoT based smart service will be the developing trends.

3 MATERIALS AND METHODOLOGY

In this study, the IoT technology was used to contact.

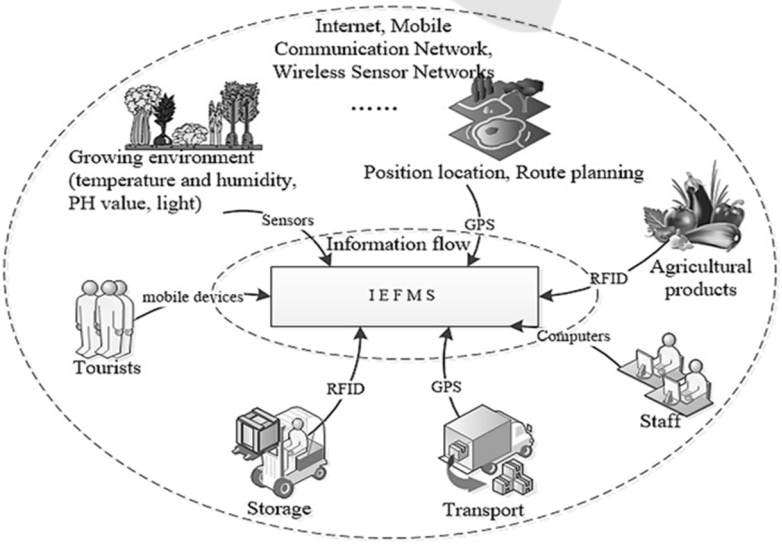

Figure 1: The IEFMS schematic diagram.

environment, facilities, roads, farm produce, vehicles and tourist in farms and an Intelligent Entertaining Farm Management System (IEFMS) was developed which realized the intelligence and active service. The IEFMS is showed in Figure 1

In production phase, a lot of sensors of temperature, humidity, PH and light intensity etc. are deployed in farmland and greenhouses for environment monitoring. When farm products are in the areas of storage, transportation and sale, the RFIDs are used to information traceability. Staffs and customers could acquire information by computers, mobile phone and other mobile communication terminals, especially during the journey.

3.1 IoT Technologies

IoT is a kind of emerging communication technology (Miorandi D. et al., 2012; Lee I. et al., 2015). It means making anything connected to the Internet though information sensing devices (such as RFID, infrared sensors, global positioning system (GPS), laser scanner and so on) with ubiquitous devices and facilities based on agreement protocol for information exchange and communication in order to realize intelligent identification, localization, tracking, monitoring and management. It includes sensors, mobile terminals, industrial system, control system, intelligent building equipment, video monitoring system, etc. with inherent intelligence. And it also has external enabled, such as Assets attaching RFID (Radio Frequency Identification) tags.

3.2 IEFMS Management System Implementation

3.2.1 Overall Architecture Design

The overall architecture of IEFMS summed up as "five layers and two systems", which showed in Figure 2. From top to bottom, the five layers respectively are show layer, application layer, application support layer, data layer and infrastructure layer. And two systems are security supporting system and application standard system.

Presentation layer: This layer is IEFMS integrated services web site, which is an important part. This layer achieved interoperability between client and server systems by HTTP/HTTPS, Web services, and mobile phone APP.

Application layer: This layer contained four application subsystems, which are Intelligent Farm Monitoring and Control System, Intelligent Farm

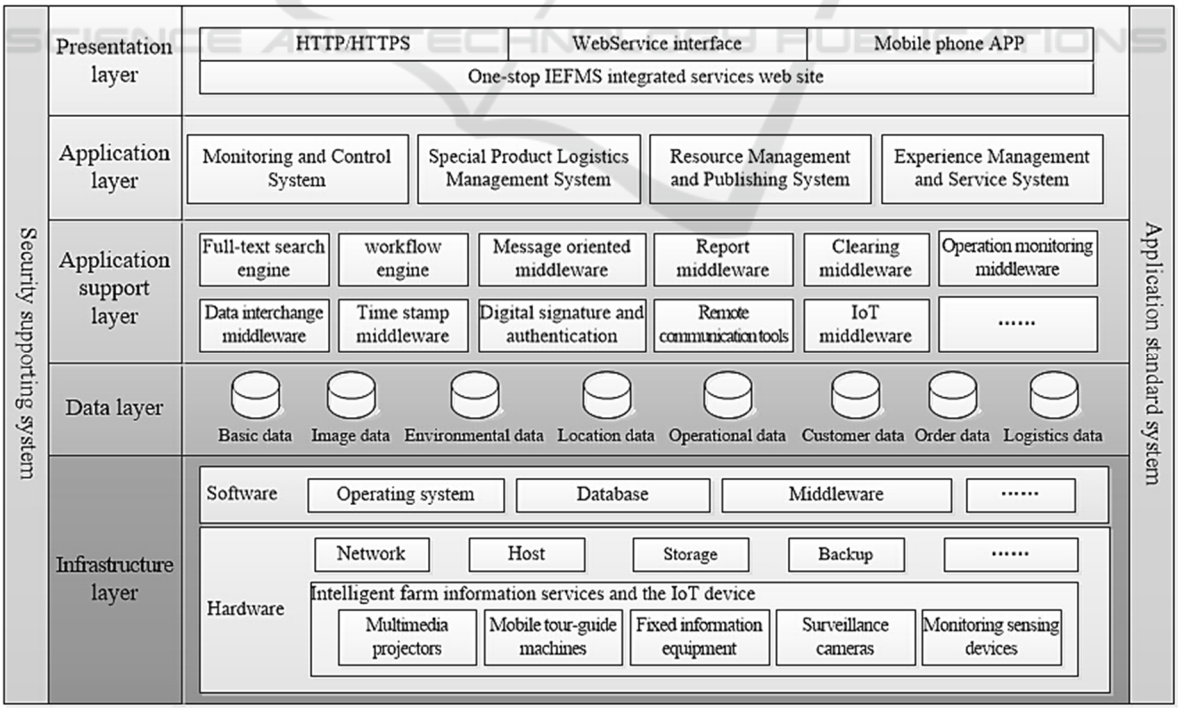

Figure 2: The overall architecture of IEFMS.

Special Product Logistics Management System, Intelligent Farm Resource Management and Publishing System and Intelligent Farm Experience Management and Service System

Application support layer: This layer between application layer and data layer provided the public function to facilitate the realization of the function of application using components and application systems. It mainly included a full-text search engine, a workflow engine, a message middleware, a report middleware, a clearing middleware and IoT middleware, etc.

Data layer: This layer stored farm people, things and money information to set up database for farm management and service including basic data, image data, environmental data, location data, operational data, customer data, order data and logistics data.

Infrastructure layer: This layer included system software, host hardware, network infrastructures, as well as farm IoT devices. And according to the requirements, the hardware and software procurement, installation and alignment was considerable.

Security supporting system: This system which ensured the safety and stability of IEFMS provided unified identity authentication service for network equipment, security equipment, application and service system by identity authentication mechanism.

Application standard system: The above layers and supporting system construction were based on the existing standards and standardize management of IEFMS, such as interface specification, standard data access, operation specification, etc.

3.2.2 IoT Devices of IEFMS

IoT devices of IEFMS showed in Figure 3. It includes five kinds of devices described below.

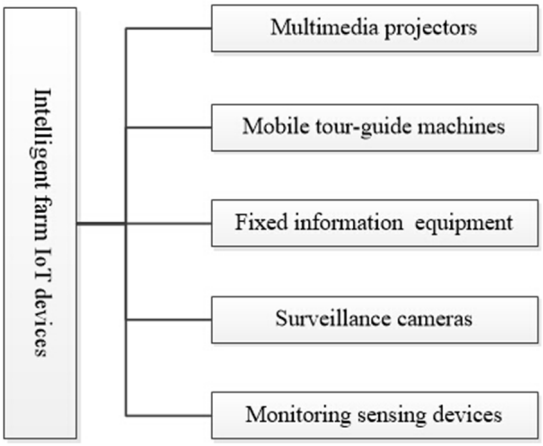

Figure 3: IoT devices of IEFMS.

Multimedia projectors: It was used to show video, audio, images, text and video of farm plant areas for publicity and promotion of agricultural science and technology knowledge.

Mobile tour-guide machines: It integrated GPS location services, RFID identification services, video service, audio service, image, text and other service functions. Combining with the farm planting zone distribution, it showed farm characteristics and let the tourists extend agriculture connotation in the process of visit through professional audio and video editing software by using digital coding and digital modulation, wireless digital signal transmitting, terrestrial digital receiving. This kind of device could be used in tourists' position. The RFID tags integrated on mobile guide device was used for identification and customer information collection when visitors enter the plantation.

Fixed information equipment: Fixed information equipment integrated touching LED display screen and computer. Using this equipment, visitors can directly query and access to information in the hall and also can self-help order characteristic farm products.

Surveillance cameras: Surveillance cameras mainly included high definition camera which were used to monitor farm environment and random sampling tourists' image information.

Monitoring sensing devices: Monitoring sensors collected plantation area environment, such as temperature, moisture, N, P, K content, pH value, organic matter content, crop's, weed distribution, etc. Through scientific configuration, real-time monitoring of environment was realized, and tourists' information was collected by integrating RFID reader.

3.2.3 Functional Design of IEFMS

Functional design of IEFMS showed in Figure 4.

Monitoring and Control System: Management and monitoring of planting zone basic information, environmental automatic gathering information and remote video information was implemented for farm management staff.

Special Product Logistics Management System: This system was used to characteristic product logistics management activities according to order situation for visitors and farm staff.

Resource Management and Publishing System: To manage all the resources, and provide in the form of SMS, mobile news to release the function of farm related information.

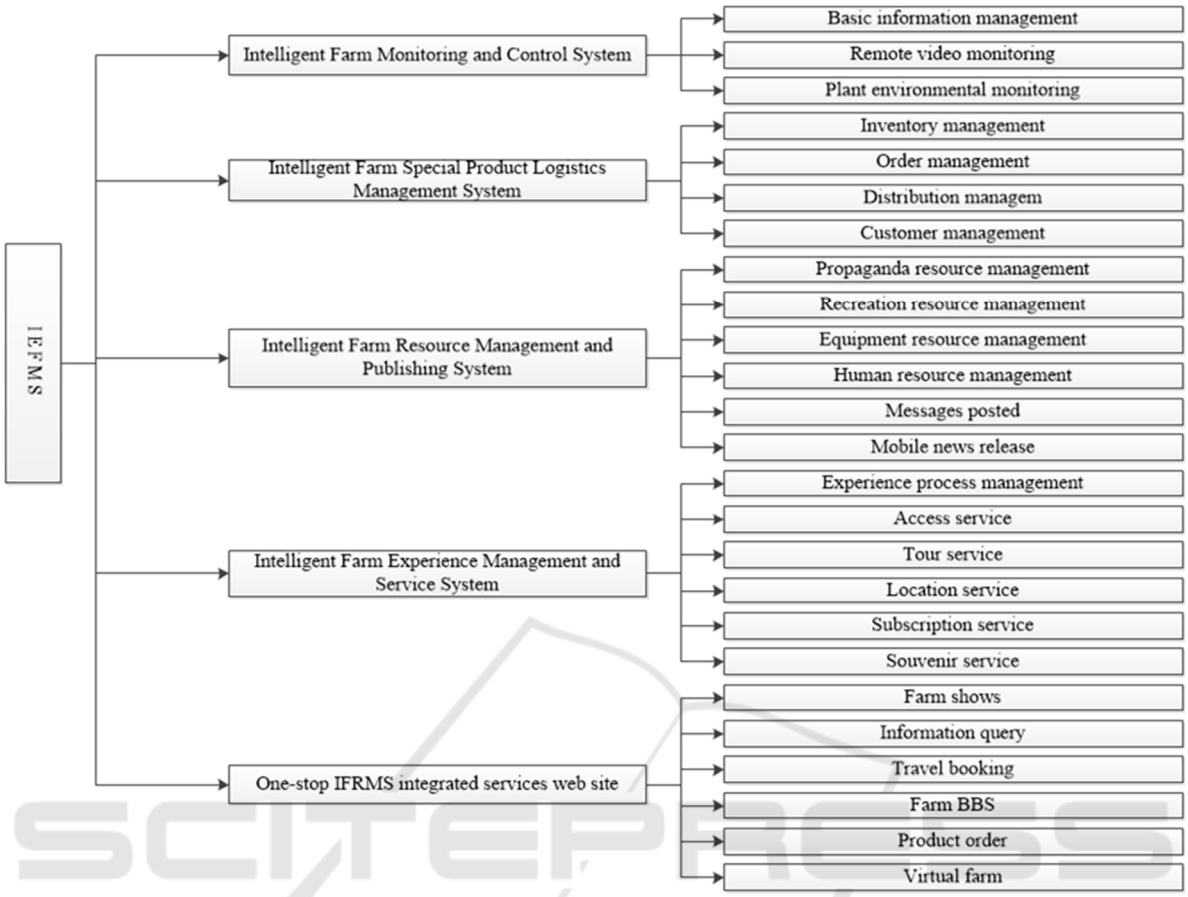

Figure 4: Functional designs of IEFMS.

Experience Management and Service System: This system provided processed, personalized, diversified experience services. It could define unique personalized experience processes according to the tourists' requirements, and offer visitors the farm access service, tour service, location service and other services.

One-stop IEFMS integrated services web site: As a showcase, the web site provided publicity materials showing, information querying, booking, farm tourism BBS, product ordering, virtual farms and other functions

3.3 Service Model

The Intelligent Entertaining Farm showed in Figure5 is divided into four parts, Planting Areas, Management Service Centre, Logistics Distribution Centre and Data Centre.

- Planting Areas

Surveillance cameras, monitoring sensing devices and multimedia projections are installed in Planting Areas which already configured the wireless network. Among them, the surveillance cameras are widely used for environmental monitoring and tourist capturing. And, on the one hand monitoring sensing devices are used to gather condition data, such as temperature and humidity. On the other hand they collect visitors' route and order information. The multimedia projections may play publicity materials to better understand farm.

- Management Service Centre

The Management Service Centre is a place for the management of cash flow, information flow, people flow and goods flow. It includes workspace and service counters. Farm staffs access IEFMS via computers with Internet connections and use IoT devices of IEFMS for Monitoring, registration, tracking and other business in word space. And tourists enjoy services from service counters.

- Logistics Distribution Centre

Logistics Distribution Centre is responsible for inventory management, order management, distribution management. The farm staffs distributed agricultural products according to the tourists' order.

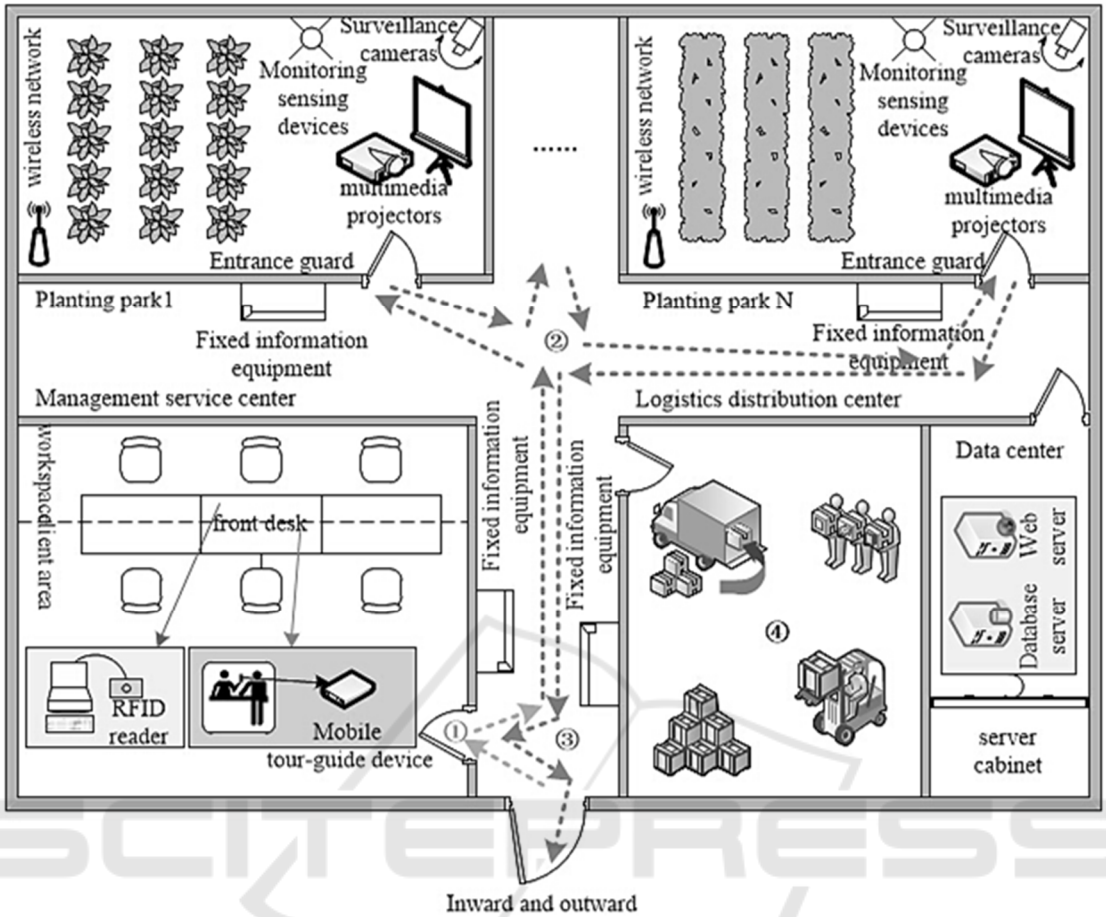

Figure 5: Service Model of IEFMS.

- Data Centre

The Data Centre is a room with a shelf of data servers and web application servers from a variety of vendors. IEFMS has been deployed in this center.

The Service Model of IEFMS including four steps.

(1) The Tourists came to farm and went into the Management Service Centre to register and get the mobile tour-guide device.

(2) The tourists took a mobile tour-guide device as entrance guard to visit and learned knowledge, entertainment through the mobile tour-guide device and multimedia projectors.

(3) After the tourists, returned mobile tour-guide device to the Management Service Centre and choose to enjoy the tour in the automatic acquisition of individualized information service, such as printed collected photo, ordering products, etc.

(4) Agricultural products were distributed in Logistics Distribution Centre according to the order situation.

4 RESULTS AND DISCUSSION

The IEFMS and its service model presented in this paper contents the following characteristics.

(1) Digital Dynamic Management

Based on a variety application of IoT technology, the real-time monitoring of farms environment was achieved. It promotes agricultural technology innovation management from point, line, surface and 3D. Point means achieving meticulous management objectives by collecting planting environment information through sensors, RFID and GPS technology. Line means getting precise planting experience according to the monitoring of the changes in agricultural cultivation, which realized the depth excavation. And analysed tours preferences according to collected tourist track action data, which implemented the horizontal excavation. Surface means relying on points and lines, the corresponding analysis and statistics were achieved, which provided dynamic management and

decision-making supports. 3D means providing traceability and management support of farm operating conditions for any point in time.

(2) Active and Customized Services

Around the needs of individual users, a personalized experience tailored processes and monitoring were achieved by using personal identification technology and access admission policy. On this basis, information resources exhibition services, text messages and mobile newspaper active push services were provided according to user customization process by using IoT devices. At the same time, IEFMS provided a wide range of user experience services based on personalized information such as location information, visit track, visiting hours, stay time, browse operations, product ordering, video images, etc. which automatically collected.

(3) Multidimensional Experience Mode

Based on multimedia information service and traces of location service, this paper proposes a multidimensional experience mode. The main body of that is large amount of information resources, such as video, audio, images, text, tourist location, tour track and so on. Relying on IEFMS services and IoT equipment, it created a variety of creative atmosphere for farm visitors, and provided different feelings of the tour. This mode further tap the customer experience value, and enhance tourist approbate degree and brand loyalty, All in all, it created a unique multi dimensions farm experience mode.

In summary, the countryside with vast and beautiful rural scenery are not only the agriculture products supply bases for cities, but expand an intelligent space for smart city. IEFMS is a new management and service model for farm development with the benefits of enhancing the agricultural increase, the rural income and the harmonic prosperity of urban and rural. And it will play an important role in the technology upgrades of traditional farmhouse and farm tours. The application of IEFMS can improve the quality of farm experience and value-added products, the core competitiveness, and the development increased like a "snowball" type virtuous circle.

5 CONCLUSIONS

Facing to the technical requirements of growing farm recreation on the intelligent management system and service model, the IEFMS and Service Model were studied combining with the technology of IoT. The results of this study will help improve intelligent farm management services, likewise providing technical and application support for the intelligentization, automation and diversification of intelligent farm relaxation service management, and also to promote adding cultural, ecological, technological and service value to intelligent farm relaxation.

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