Design and Production of Camel Phenotyping Assistance System

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Abstract

**Background:** One of the significant challenges in camel husbandry is the lack of records and characterization of economically and health-relevant phenotypes. There are many fundamental problems due to their dispersion and the nature of the camel grassland farming specially phenotyping of camels. People's participation in the design and implementation of livestock and agriculture development programs is a straightforward matter, and an inevitable necessity and they should be involved in all cases and aspects of the programs.

**Methods:** This research aims to design and set up a system in order to establish communication and networking among herds, phenotyping, and tracking of camels. The capabilities of camel phenotyping assistance system include: registration of the herd characteristics, camel tracker, estimation of body weight, and training, developed in cell phone platform.

**Results:** This system, named SAREBANYAR, will improve data collection and can undoubtedly pave the way for the development of applied research to improve camel production traits. It also provides the skills training for the camel owners and will also increase the herd's performance.

Introduction

Nowadays, the advanced agricultural technologies have provided a new path with better facilities for farmers as well as agricultural applications. Cell phone smart technologies and applications have become the center of these global developments. The innovative farming trend has been growing for a long time and does not seem to stop soon. Nowadays, there are dozens of applications to solve agricultural problems. These applications help farmers manage their crops by collecting valuable data. These services effectively improve the crop yield and will lead to a more accurate evaluation of the grasslands’ circumstances. By improving the link among producers, suppliers, and value chains, the buyers have become more transparent, efficient, and are less manipulated by intermediaries. By accessing the budget, insurance opportunities, and alternative payment methods, farmers can increase crop yields, diversify production and reduce economic losses (Ghanbari Shirsavar, 2020).

Approximately 41.4% of Iran's grasslands are medium quality ones, and 48.2% of them are poor (unproductive and relatively saline) grasslands. Camels are one of the most suitable livestock for breeding in these areas where nothing grows but saline plants. The use of camel meat as a source of protein is common in urban and rural communities, and its wool and fiber are usually used to provide some of the raw materials for the textile industry. There is a solid motivation to start camel research projects to improve the production capacity of this unique livestock for people who are focused on sustainable agriculture (Gharadaghi and Salehi, 2013). Components of sustainable development include quality, biodiversity, environment, and economy. Camel products are essential in terms of quality and health. Camel breeding is also significant in terms of biodiversity and environmental adaptability. About,
concerning camel breeding profitability in the short and long term, an increase in the breeding of this animal will pave the way for sustainable development.

There are ~150,000 dromedaries in the southern and central deserts of Iran (FAO, 2019) that they were distributed in 14 provinces of the country (Gharadaghi and Salehi, 2013). Improvement and animal breeding goals in this profitable livestock should be coordinated with the production goals of camel owners, their general environment, and their management capacity so that the existing conditions of camel breeding systems should be considered in the development of animal breeding programs. Genetic improvement should be created based on scientific facts and indigenous knowledge of camel owners (Ishagh and Ahmad, 2011). The aim of animal breeding and economic values of attributes, which affect profitability, have not been included in any of the camel breeding systems in Iran (Vatankhah, 2016). The yield of camel milk and meat production in Iran is meager, and almost no action has been taken so far to improve the production attributes in camels, except for some minimal choices based on phenotype or the minimal impact of random migration. Factors such as lack of sufficient records, pedigree, small herd size, lack of kinship among herds, and lack of evaluations within and among herds on the one hand and the difficulty of accessing the camel owners, on the other hand, have prevented significant progress in improving the camel production attributes. One of the ways to overcome these problems is to network and facilitate the recording and recording of information (Vatankhah, 2016). People's participation in the design and implementation of livestock and agriculture development programs is a clear matter and an inevitable necessity, and they should be involved in all cases and aspects of the programs. This research aims to design and set up a system in order to establish communication and networking among herds, phenotyping, and tracking of camels. One of the essential goals of producing this system is the development and facilitation of communication with the people's herds concerning the vastness of the region and the high dispersion of camel owners. Facilitation of the identification, registration and recording of camel herds are the other capabilities of system. With the design and development of this system, access to information on camel herds will increase and can undoubtedly pave the way for the development of applied research.

**Materials And Methods**

**System design**

This system includes three main sections: server, management panel and mobile phone application (Fig. 1). First section contain database and back end. The second section includes a web based management panel which the manager can observe and manage the herd information, the required training and instructions and so on. The third section includes the Herd Owner Users Application, named SAREBANYAR, which is available to any owner of the herd. These can use it to observe and edit the information of camels in his/her own herd. The main part of this application include: user login (information security), breeder (farmer) information, general herd information, herd camels’ information management, training and instructions, and smart camel weight estimation based on body measurements (Asadzadeh et al, 2021, Guang-Bin et al, 2011), camel tracker, and alerts. The R scripts
and results of Machin learning to weight estimation are publicly available in GitHub repository (https://github.com/Ehsan-Shams-Davodly/Camel-phenotyping-assistance-system/tree/main/Camel%20weight%20estimation/Result). The Persian version of system has been launched in some herds in Iran and supported by the Animal Sciences Research Institute of Iran. The source of application was uploaded in GitHub repository (https://github.com/Ehsan-Shams-Davodly/Camel-phenotyping-assistance-system/tree/main/AndroidApp). The next version will be bilingual.

**Programming Language**

The programming language was considered on a server based on Python and PHP with MySQL database. The admin panel in this system is a web-based application in which the programming language used is considered to be PHP and CSS (Cascading Style Sheet). It is possible to observe and report information in a specific structure and to back up the camels’ information (it is also possible for the admin to change the camels' information and any changes in the information will be saved along with its username) in the admin panel. In addition, the ability to observe, edit, delete and add breeding technical instructions is considered. The possibility of search is also considered in the sections of viewing camel information and viewing the instructions and only the system administrator can access the admin panel by a specific username and password.

**Camel Tracking**

A hardware tracker gets attached on a camel neck. A SIM card (preferably, the SIM card of the operator, which has a higher capacity antenna in the area, should be used) is placed in it by the camel owner. The connection to the central server is via the internet and if there is no access to the SIM card internet, information can be sent via SMS.

**Results**

**Data collection**

Camel owner can quickly enter the herd information into his/her mobile phone and use its capabilities using the SARBANYAR Application (Table 1). One of the most important features of this system is access to the information of the camels of the herds covered by the plan and it would be possible to prepare a record remotely in the mobile platform (Fig. 2). All of the information, entered using SAREBANYAR app, is quickly accessible in the admin panel and possible to report in Excel format.

**Estimation Of Body Weight**
It is possible to estimate the body weight using five measurements (head length, hump girth, chest girth, abdominal width, and withers to pelvic length) by this application.

**Training Platform**

In the admin panel, it is possible to upload promotional and educational materials, after which the user can access the content in the application in the training section.

<table>
<thead>
<tr>
<th>camel owner and herd</th>
<th>Individual records of camels</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>Photo</td>
</tr>
<tr>
<td>county</td>
<td>ID (unique necessary code)</td>
</tr>
<tr>
<td>local name of geographical area</td>
<td>recording date</td>
</tr>
<tr>
<td>geographical characteristics</td>
<td>local name</td>
</tr>
<tr>
<td>how to supply water to the herd</td>
<td>Gender</td>
</tr>
<tr>
<td>electrical conductivity of water</td>
<td>date of birth</td>
</tr>
<tr>
<td>vegetation of the area</td>
<td>body color</td>
</tr>
<tr>
<td>total number of camels</td>
<td>name of sire and dam</td>
</tr>
<tr>
<td>number of herdsmen</td>
<td>year of birth of parents</td>
</tr>
<tr>
<td>name of bull camel</td>
<td>approximate weight of mother</td>
</tr>
<tr>
<td>the approximate weight of herd</td>
<td>number of teeth</td>
</tr>
<tr>
<td>milk production extent</td>
<td></td>
</tr>
<tr>
<td>disease history</td>
<td></td>
</tr>
<tr>
<td>Culling date</td>
<td></td>
</tr>
<tr>
<td>Sale date</td>
<td></td>
</tr>
</tbody>
</table>

**Camel Tracker**

This tracker has an internal battery that can be recharged. The response time with a single charge depends on the type of battery and its power. Using eight small solar panels on the tracker necklace will cause the charge of the battery by sunlight and the battery response time will last longer in this case.
Routes traveled by camel, warning in order to prevent road and rail accidents are other features of this application. If you do not have access to the network, the spatial information gets stored in the internal memory of the tracker, and if you access the network, all the stored information will be sent to the server. The location error of the tracker is considered to be less than 10 meters. Trackers’ information is sent to the central server at the moment by the tracker and the information is located on the central server, and the tracker location information can be stored for up to one year (previous information get cleared from the server) based on the server limitation. Location information on the server is sent to the application and the admin panel for display. For information security and secure storage, location information is not stored on the mobile phone and application. Possibility to view the location of each camel on the map and view the routes traveled by each camel on the map, report location and temporal information in a suitable format for research affairs, managing the SMS panel settings, and viewing authorized and unauthorized areas defined by camel owner are features of the tracker section in the admin panel.

Creation Of A User Account And Information Synchronization

To enter this application, each person must wait for his/her identity to be verified by the system administrator after entering his/her phone number, then the person can use the application. The user must create a new information record for each camel. He/she can also view and edit previous information. Since it is not possible to access the internet in all locations, so, the users should select the information synchronization option in the program after entering the areas with the ability to access the internet, to upload their changed information as well as to upload new information.

Conclusions

All the information entered by the camel owner in the application is stored in the database and the system administrator can access the information collected from the individual herds. The status of each herd will be created separately by analyzing the data. The camel owner enters his/her herd information into his/her mobile phone using the SARBANYAR Application and uses its capabilities. The features of this application include: users login control (information security), herd information, herd camels’ information, trainings and instructions, camel weight estimation based on body measurements, online monitoring of camels, and awareness of warnings and notifications. The PNLSVM model was proposed to estimate the body weight from body metrics in this system. In addition to developing and facilitating communication among camel herders, using this application will be very effective in identification, registration and recording of camels. It will also pave the way for improving camel breeding management by providing skills trainings in the mobile platform. Online monitoring of camels should be effective as one of the solutions to notifications and prevention road of and rail accidents.

Declarations
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Conflicts of interest/Competing interests

The authors declare no conflict of interest.

Ethics approval

The work was approved by ASRI's Animal Ethics Committee (the number ASRI-0-13-13-018-990196).

Code availability


Author Contributions

Conceptualization, M.B.S., J.Z.H., S.E. and M.H.B.; methodology, M.B.S., J.Z.H., M.H.B. and A.S.N.; software, M.B.S. and E.Sh.D.; formal analysis, E.Sh.D.; investigation, M.B.S., N.A. and A.M.; writing—original draft preparation, M.B.S.; writing—review and editing, S.E., M.H.B. and P.A.B.; visualization, M.B.S. and E.Sh.D.; supervision, M.H.B., S.E. and P.A.B. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Conflicts of Interest

The authors declare no conflict of interest.

References


**Figures**

![Diagram](image)

**Figure 1**

The camel phenotyping assistance system
Figure 2

The camel phenotyping assistance system (SAREBANYAR app)

Figure 3

Camel tracker, location on the map, and hazard areas