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Development of Program Architecture of Intelligence Information System for Growing Tea Plantation

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Abstract In this paper, the problem of program architecture creation for providing collection of intelligence information of growing tea plantation is considered. For efficiensy growing tea plantation in the mountain region of Azerbaijan, program interface of intelligence information system (IIS) is offered. On the stages, all program functions of IIS and its connection with other the special program systems are given, which must provide executive of automation irrigation system, agrotechnical works and collection of quality tea leafs from the tea plantations.

Keywords Program architecture, Information system, Tea plantation, Automation, Intelligence, Irrigation

1. Introduction

In order to develop of the sector tea-growing in the Republic of Azerbaijan, solution of the problems of efficient irrigation, the timely and proper execution of agrotechnical works, collection and accounting of the problems of quality tea leaves are needed. In this connection, the problem of working out program architecture for executing procedures of forming database with informations about tea plants in the Azerbaijan subtropical mountains regions [1] and varieties of growing teas, theirs biological characteristics; realization of automation irrigation, agrotechnical works with using current meteorology and soil informations; also collection of quality tea leafs and theirs control are considered in the paper. At creation of that program architecture, use of principals of artifical intelligence, forming expert information, interface with control system of irrigation, agrotechnical works and accounting tea leafs are needed, because growing tea plants and quality tea leafs is difficult and long process.

In order to develope of special program of intelligence information system for growing tea plantation in the mountain region, the following complex problems have to be solved [2, 3]:

1. It is needed to create intelligence control system for growing and collection of quality tea leafs from tea plantation and productivity of tea plantation in the subtropical mountain region of Azerbaijan.

2. It is needed to provide high-quality work of automation system of irrigation for tea plantation and right executing agrotechnical procedures in the subtropical mountain region of Azerbaijan.

3. Creation of the database system and its control of the needed informations for providing quality growing tea plantation and collection of the tea leafs at the period of moon calendar.

Analyze of information by problem of tea plantation growing shown that for growing quality tea bushes, theirs location on the foot places of mountain, providing water balance in the land soil, timely pruning tea bushes, natural mineral feeding and keeping the collection of qualitative and accurate accounting of tea are required. As these issues are executed by the experts in agro-engineering, then they are based on intuitive knowledge [4, 5]. The process of cultivation of tea plantations, especially in the areas of non-smooth is compounded, because of the mountainous terrain areas, agro-technical studies on tea bushes, irrigation process are became more difficulty. The impact of meteorological parameters are uncertain, and the tea leaves of tea bushes is negative impact on the biological properties of the assembly process.

The above-mentioned issues, the specialist to perform more effectively substituting complex intellectual information system (IIS) should be established.

2. Investigation of the Problem of the Growing Tea Plantation on the Hierarchy Levels of IIS

Data base of IIS for the growing tea plantation includes types of tea bushes, biological characteristics and identified areas of planting which are stored in the hierarchy level 1 of the system memory. In depending on the type of tea bush to

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the database, the following informations are included: tea bushes elliptical or circular leaf and theirs sizes, quantity and size of white flowers and theirs sizes [6].

In the 2nd hierarchy level of IIS for the growing tea plantation with the demands of tea bush cultivation and collection, the data for the regions of Azerbaijan, reflecting annual climate are saved. Current meteorological data for ensuring efficient cultivation of tea plantations in the region of Azerbaijan from Internet are recorded in the working base of İİS.

If "The annual average climatic value", "Current meteorology value" and "The necessary meteorology characteristics" are written as $\dot{I}_i$, C_i, T_i, (where $i = \overline{1,5}$) then data "Temperature", "Relative humidity", "Rain amount", "Wind speed" and "Day's light time" are written as T_{hj}, R_{nj}, M_{yj}, S_{kj}, $\dot{I}V_{gj}$ (where $i = \overline{1,3}$). Belonging to tea plantation region and number of plantation is written by means of the following logical equation [7]:

$$R\_n(tea\_plant) \rightarrow \begin{cases} \forall\, \dot{I}_i \in \left(Th_j, Rn_j, My_j, Sk_j, \dot{I}Vg_j\right); \\ \forall\, C_i \in \left(Th_j, Rn_j, My_j, Sk_j, \dot{I}Vg_j\right); \\ \forall\, T_i \in \left(Th_j, Rn_j, My_j, Sk_j, \dot{I}Vg_j\right). \end{cases}$$

In depending on the region's climate, current meteorological values and cultivation of tea plantations in the region, the indicators for collecting the required meteoroloji irrigation method is chosen. For example, if in this region $C_i(Rn_j)$ $T_i(Rn_j)$ is lower, then the leaves of the tea bushes is irrigated with water spray (as fog-like particles disperse rain). In this case, the logical expression is written as follows:

$(C_i\left(Rn_j\right) \ll T_i(Rn_j)) \rightarrow$ *(Irrigation method – dispersion* (S_s)*),*

where working time of the Ss must be get like the value of $T_i(Rn_j)$. In this connection for providing relative humidity of leaves of tea bushes, air humidity increase by means of artificial irrigation is required. The relative humidity in Zagatala region are $C_i\left(Rn_j\right) = 52\%$ and $T_i(Rn_j)=78\%$ at 01.08.2016. For the relative humidity increase of the tea bushes on tea plantations, additionally spray irrigation is required.

One of the most important issues for the growth of tea plantation is holding of the required water balance for the roots of tea bushes. In this case, rain method of irrigation to tea plantation is chosen. At this period in the tea bush root is moistened quickly. Thus, water consumption is reduced. Water balance is determined by the formula [8]:

$$V_{TP} = \frac{R^3}{h_R^3 - R^3},$$

where R – the distance part of tea plantation land fed by water (mm); h_R –the dry part distance of tea plantation where water entered the land (mm).

For keeping the required relative humidity level in the land of tea bush, a sensor controlling the presence relative humidity value send to that information to programming logical controller which realize a management of the irrigation system on 3th level of IIS.

On the 3th hierarchy level of İİS for the cultivation of tea plantation, the interface between the system information and technical tools are provided. The automated work place, the automated irrigation system, the control system, local and global network for providing complex information about the current meteorology values, water balance of the land of tea plantations and the communications system are used.

3. Creation of Program Architecture of Intelligence Information System for Growing Tea Plantation

On the basis of the important scientific problems by growing and collection of tea plantation [9] architecture of program of intelligence information system for growing tea plantation in the mountain region (figure 1).

Under the architecture of program of intelligence information system (IIS) for growing tea plantation in the mountain region the following program functions are executed:

1-st stage: Under Windows system the interface panel of the program architecture is realized. From *"Database of tea plantations in the sown area"*, program block of the tea plantations verieties in the mountain region of Zaqatala, theirs biology characteristics are inputed, and also it is defined number of tea plantation. Program functional scheme of the first stage procedures is shown in fig. 2.

2-nd stage: From *"Meteorology parameters of the job base of tea plantation area"* block, menu procedures of the managment panel of the intelligence information system are executed (fig. 3). The meteorology data which choosen from GİSMETEO.RU, are entered the current base and saved in the access memory of the system.

On the basis of meteorology data of Zaqatala region of Azerbaijan, program procedures of "Automation system of tea plantation irrigation" menu bloks are activated.

3-d stage: *"Program block of automation irrigation system for tea plantation"* is executed (Fig. 4). On the basis of the irrigation requirements, managment algorithm of tea plantation irragation by means of fuzzy logic method in program system of MatLab is worked out. The tested management program is transformed to the control algorithm of fuzzy controller. The fuzzy managment algorithm of automation irrigation system (AIS) is created by means of expert information. On the basis of comparing functions of AIS managment program with current meteorology parameters, azone or rain type of irrigation is choosen.

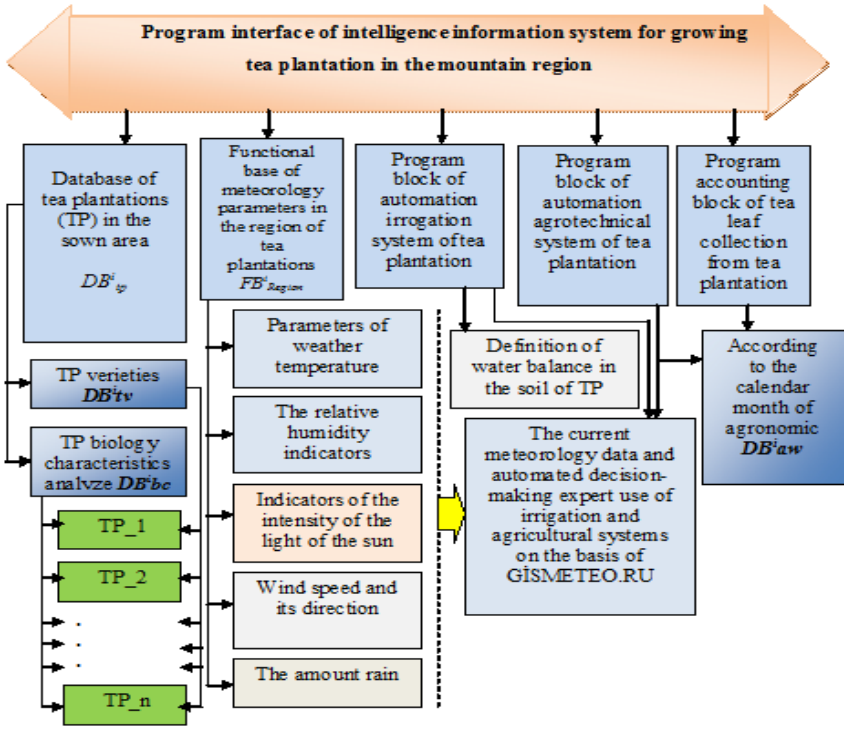


Figure 1. Program architecture of intelligence information system for growing tea plantation in the mountain region

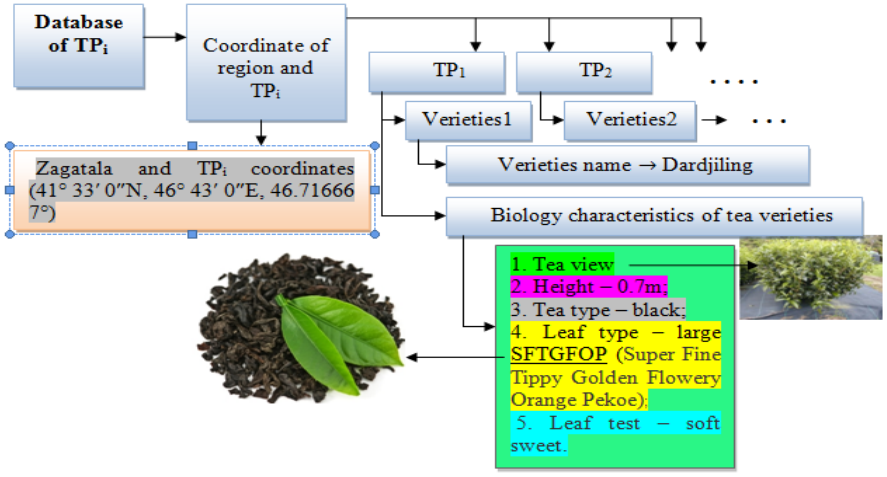


Figure 2. Functional cheme of data base of intelligence information system for growing tea plantation

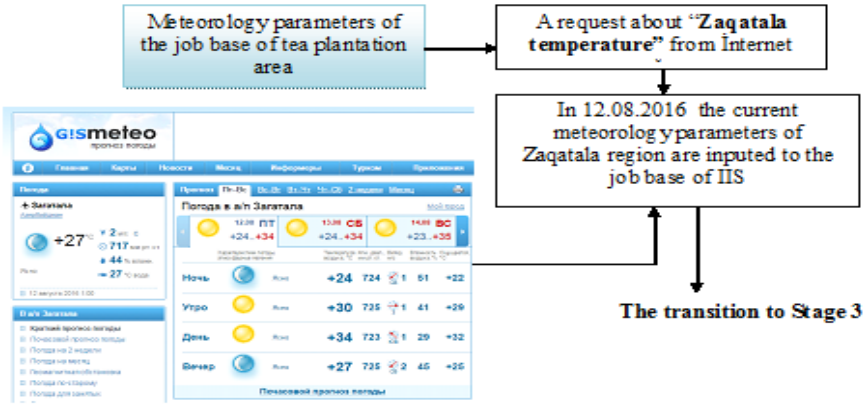


Figure 3. The functional scheme of the job base of IIS for tea plantation with use current meteorology parameters

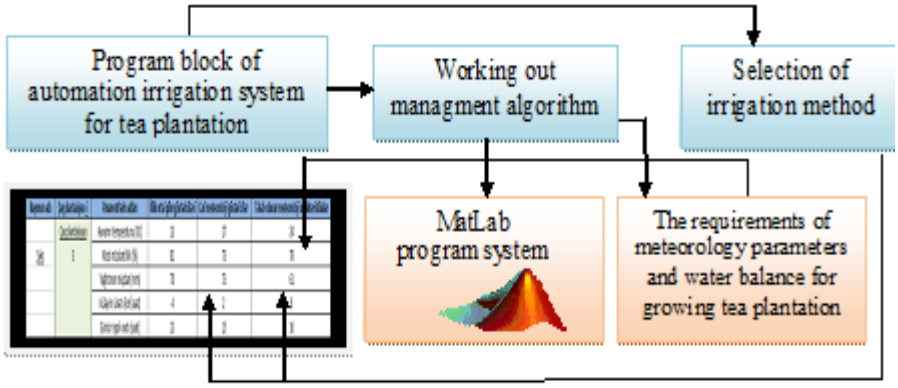


Figure 4. Functional scheme of program block of the automation irrigation system

Managment algorithm of tea plantation irragation by means of fuzzy logic method [5, 6] in program system of MatLab is worked out on the basis of the expert data. As shown in the paper [6], for creating management algorithm of technical system, analyze of its technology process and expert knowledge collection are necessary. In this connection, for providing effective irrigation of tea plantation, on the basis of data of relative air humidity and water balanse of sown area of the tea plantation, the fuzzy algorithm must be worked out. In this case, the following lingvistical veriables in the controller input of the automation irrigation system are used [10]:

1. On the controller input (internal variebles):

1.1. Relative humidity (*Rh*);
1.2. Soil water balance (*Swb*).

2. On the controller output (external variebles):

2.1. Water pump (Wp) operating time;
2.2. Water pump operating mode – rain irrigation;
2.3. Water pump operating mode – ozone irrigation.

The lyngvistical terms on the basis of relative humidity are written as follows:

Rh_1 → relative humidity is much lower than the norm (58 62 66 %);

Rh_2 → relative humidity is lower than the norm (66 70 74 %);

Rh_3 → relative humidity is suitable norm (74 78 82 %);

The lyngvistical terms on the basis of soil water balance are written as follows:

Swb_1→ soil water balance is much less than the norm (0.112 0.115 0.118 m^3);

Swb_2 → soil water balance is less than the norm (0.117 0.120 0.123 m^3);

Swb_3 → soil water balance is suffice (0.123 0.126 0.128 m^3);

The lyngvistical terms on the basis of rejimes of water pump are as follows:

Wp_1 → water pump works zero time;
Wp_2 → water pump works very short time;
Wp_3 → water pump works short time;
Wp_4 → water pump rejime is rain type;
Wp_5→ water pump rejime is ozone type;

On the basis of fuzzy lyngvistical terms of relative humidity and soil water balance, management algorithm of irrigation system is worked out as follows:

IF "*Relative humidity is much lower than the norm* (60)";
AND "*Soil water balance is suitable norm* (0.127)"
THEN "*Water pump rejime is ozone type*";
THEN "*Water pump works short time*".
IF "*Soil water balance is much less than the norm* (0.115)";
AND "*Relative humidity is suitable norm* (76)"
THEN "*Water pump works short time*".
IF "*Soil water balance is less than the norm* (0.119)";
AND "*Relative humidity is lower than the norm* (71);
THEN "*Water pump works very short time*";
THEN "*Water pump rejime is ozone type*";
THEN "*Water pump rejime is rain type*".

4-th stage: *"Program block of automation agrotechnical system for tea plantation"* menu's commands are choosen. On the basis of the current meteorology parameters of the region and the Moon calendar from İnternet, some agrotechnical works (pruning, spraying, giving manure, planting tea bush and other) are determined (Fig.5).

Functions of program tool of IIS for growing tea plantation are executed by interface with technical tools of automation irrigation and agrotechnical systems by means of fuzzy controller, temperature sensor, relative humidity sensor, soil water balance fixing sensor, agrotechnical equipments.

5-th stage: By means of the Moon colendar and meteorology parameters, *"The Program accounting tea leaf collection from tea plantation"* menu block is activised. The accoun of collection of tea leafs and them receiving from every tea plantation are executed in special service of the program block. Tea leaf type, quantity, quality, price and accept the date, time, "Account database (ADB_{ij})" are saved in the IIS (Fig. 6).

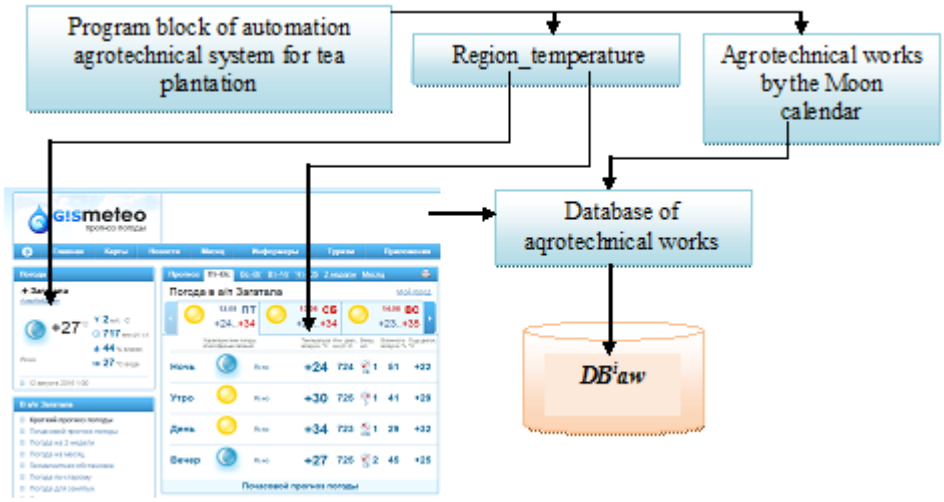
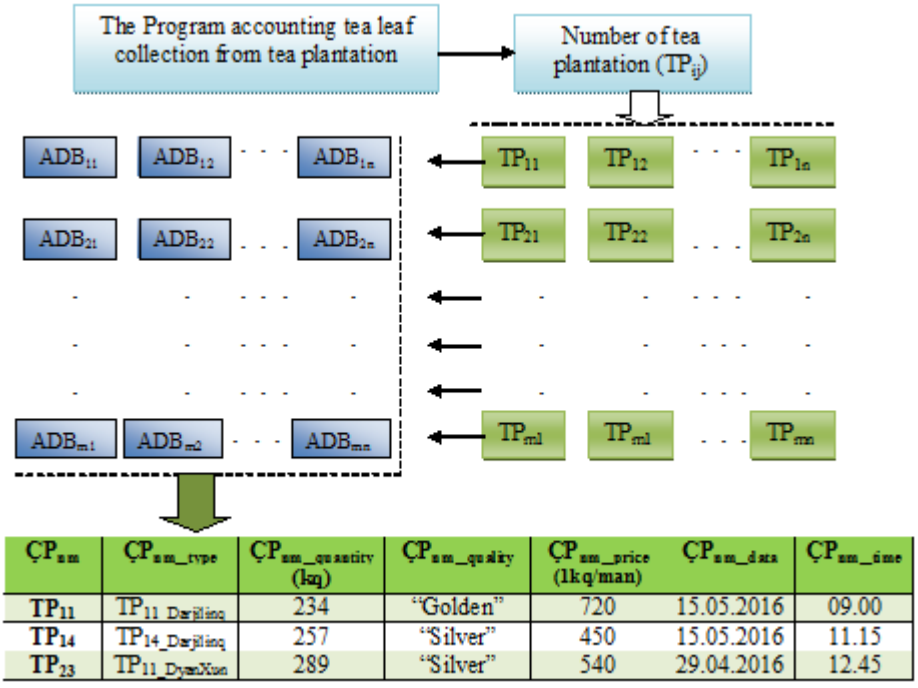


Figure 5. Functional scheme of program block of automation agrotechnical system for tea plantation



ÇPnn	ÇPnn_type	ÇPnn_quantity (kq)	ÇPnn_quality	ÇPnn_price (1kq/man)	ÇPnn_data	ÇPnn_time
TP11	TP11_Darjiling	234	"Golden"	720	15.05.2016	09.00
TP14	TP14_Darjiling	257	"Silver"	450	15.05.2016	11.15
TP23	TP11_DyanXun	289	"Silver"	540	29.04.2016	12.45

Figure 6. Functional scheme of menu block of the program accounting tea leaf collection from tea plantation

4. Conclusions

The made investigation by problem of efficiensy location and growing tea plantations on the mountain regions of Azerbaijan allows to do the following conclusions and get the finaly results:

1. In a result of analyze and the investigation of the problem of growing tea plantations in the word and Azebaijan, the basis directions of forming architecture of intelligence information system for efficiensy growing tea plantation have been defined.
2. It was offered the architecture of intelligence information system for growing tea plantation in the mountain regions;
3. There were given the basis procedures of program functions on the stages working of IIS for growing tea plantation in the mountain regions;
4. Managment algorithm of tea plantation irragation by means of fuzzy logic method in program system of MatLab on the basis of the expert data is worked out.

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