

# Conceptual model of the information system for the automation of personalized email distribution

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**Abstract**—A conceptual model and information system architecture for solving the task of automating personalized email distribution is proposed.

**Keywords**—automated information system; electronic mailing; personalized communication channel; institutions of higher education.

## I. INTRODUCTION

In the era of the development of digital technologies and the transition of education to a new level, higher education institutions need to implement new communication tools with partners, teachers, and students in order to keep up with the times and constantly develop and improve their activities. One of the effective tools of communication today is email marketing, which is gaining momentum over time, is updated and is increasingly used by organizations to increase the effectiveness of marketing activities. Email marketing is a tool for reaching out to people who use email for business or personal communication in their everyday lives [1].

All emails can be roughly divided into following groups: automatic mailing, common and official letters. The following services are used for mass email distribution: MailChimp, Sendinblue, BenchMark, Zoho Campaigns, Vertical Response, and others [1].

## II. PROBLEM STATEMENT

Sending personalized emails manually involves the following steps: categorizing contacts, creating a personalized email, email subject, email content, adding attachments, if needed, or sending the email or scheduling it to be sent. The listed steps of processing one sheet require almost 1 minute of time. To date, the limit for sending mail using the Gmail service is 500 letters during the day [2]. Thus, the total duration of continuous manual processing of such a number of sheets is about 8.33 hours.

On the other hand, automated information systems for the implementation of personalized email newsletters have the following advantages: they increase the quality and efficiency of communication, contribute to the

reduction of labor intensity and time consumption, meet the requirements of individual personalized communication, contribute to the reduction of errors, allow efficient use of resources, have a professional design and are less error-prone.

Most of the email services are paid, however, most of them offer a trial version. Their comparative analysis according to such criteria as advantages and disadvantages, language of the interface and support, limitations of the free version, integration with external services, shows that today there are no services for personalized email newsletters, firstly, with a Ukrainian language interface and, secondly, which would allow mass mailing and would be relatively free.

## III. ER-MODEL DESIGN

To implement an email mails sending system, the following relational database schema is proposed (Fig. 1). The entity *contact\_categories* is used for contacts categorization – NUWEE (for National University of Water and Environmental Engineering contacts), FOREIGN (contacts of foreign researchers), UKRAINE (contacts of Ukrainian researchers), and PERSONAL (personal email addresses). The *contacts* entity is needed to store information about researcher contacts, including their name, surname, email address, phone number, contact category, and university. The *universities* entity contains information about universities. The *mails* entity contains all the information required for sending an email, including the subject, email body, sender's and recipient's addresses. Since email attachments are not structured data and often have binary formats, storing attachment files is not appropriate in a relational database. It is more appropriate to use blob storages such as Amazon Web Services (AWS S3) for attachment storage. However, in the relational database, we must store metadata about attachments, including the file name, type, size, storage URL path, and a reference to the email the attachment belongs to. The *schedule* entity is designed for delayed email sending and contains references to the email to be sent, as well as the date and time of sending.

To set up email sending automation, the user needs to perform the following steps:

- Log in to the system.
- Add email addresses of contacts to the list and categorize them if necessary.
- Create an email message and optionally attach any number of files.

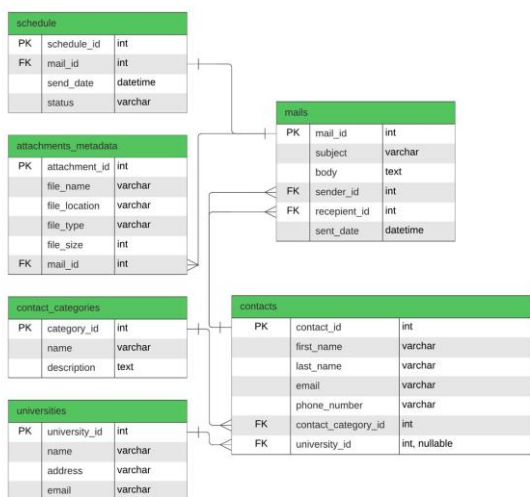


Figure 1. ER model of the information system

Select the necessary recipient addresses and specify the date and time of sending, if delayed sending is required.

#### IV. SYSTEM ARCHITECTURE DESIGN

Let's review the architecture of the automated email newsletter system (Fig. 2).

*NUWEE cluster* is a cluster consisting of any number of servers that have one of two roles:

*gateway* – servers, which process user requests and store data of contacts, universities, and email attachments in the relational database service (RDS), or in case of attachments, in the file storage (AWS S3);

*cron-mail-sender*, which periodically queries the email sending schedule database (AWS Dynamo DB), and when it finds corresponding emails, converts them into the required format for the email server and sends them using the AWS SES email sending service.

*AWS S3* is a service that is capable of efficiently storing large unstructured files, which is why this service was chosen to store email attachments.

*AWS RDS* is a relational database service that will be used to store contacts, contact categories, emails, and attachments metadata.

*AWS Dynamo DB* is a NoSQL database service that is well-suited for storing unstructured data, such as the email sending schedule.

*AWS SES* (AWS Simple Email Service) is an email sending service that can efficiently send substantial volumes of messages using Simple Mail Transfer Protocol (SMTP) format.

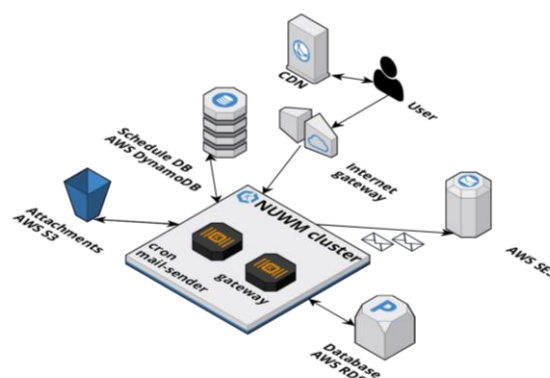


Figure 2. Architecture of the automated email newsletter system

*Internet Gateway* (IGW) is an infrastructure component responsible for handling user requests. Additionally, in order to improve the delivery of frontend resources, it was decided to use *AWS CDN* (AWS Content Delivery Network), which allows caching resources at locations closest to the end-user.

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#### CONCLUSIONS

It is expected that the Ukrainian language automated information system for sending personalized emails will contribute to: improving the efficiency of communication and time consumption, personalization, improving the quality of communication, errors reducing, saving of the resources, tracking results, and will have a professional attitude.

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