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REALIZATION OF PHOTO BOOTH BY RASPBERRY PI

Urgency of the research. *Nowadays, the deployment of low-cost platforms, such as Raspberry Pi is applied not only in educational or hobby projects, but it finds application also in industry or various commercial products. Therefore, it is crucial to explore the possibilities of using such low-cost systems.*

Target setting. *The research aimed to create a "low-cost" photo booth that would be comparable or better in parameters to commercial solutions, but at a much lower cost.*

Actual scientific researches and issues analysis. *When designing the system and preparing this paper, we considered both current sources – publications and papers dealing with the current state of development of the photo booth as well as existing solutions, which are available on the market.*

Uninvestigated parts of general matters defining*. The created photo booth solution currently neither have printing applied, nor send the resulting photos to email or cloud automatically. It will be implemented in the next stage of development.*

The research objective. *The purpose of this article is to explain how we can create original photo booth using Raspberry Pi platform.*

The statement of basic materials. *We used single-board low-cost microcomputer Raspberry Pi, and in combination with a camera, we made a photo booth. For this system, we created a control program in the Python environment, which is one of the most widespread programming languages and finds application in various areas.*

Conclusions. *Using the Raspberry Pi and the camera, we created a fully functional photo booth qualitatively comparable to commercially available products at a much lower price.*

Keywords: *Raspberry Pi (RPi); Python; Photo booth.*
Fig.: 8. References: 12.

Introduction. A photo booth is an automatic device or kiosk that uses an automatic process to take photos of an individual or a group of people. It can create a single photo or a series of photos. Photo booths can be divided into two categories. Enclosed photo booths are often used in public spaces. The image size of the photo is from the waist up and is mostly used for use in documents.

Newer types of cabins are open photo booths, which can take photographs of a larger number of people. It is a small box, which is very easy to operate with one touch. Either a single photo or a series of multiple photos is created. If a series of photos are created, there is a pause of a few seconds between each photo to change poses or exchange props. Numerical countdown signals about this pause on display or a LED before the next photo is taken. The photos can be sent by e-mail, printed on-site, or sent via MMS. This type of photo booth should include an extensive display so that all customers can see the timer or live preview of photos. Such photo booths are mostly used at weddings, parties, corporate events, festivals, and other social events [1].

Our goal was to create an open photo booth. Before presenting our own solution, we will give examples of commercially available photo booths.

HootBooth® DSLR EventPRO Augmented Reality Photo Booth. This photo booth (Fig. 1) is produced by Hootbooth, based in the United States. It includes a 12.3″ touch screen monitor in the form of a Microsoft Surface Pro 6 tablet with an i5 processor and uses the Windows operating system. Photos are taken with the Canon EOS M50. Its stand is made of steel, and the packaging of all hardware components is made of aluminium. This photo booth weighs approximately 12.2 kg [2].

Fig. 1. HootBooth® DSLR Event PRO Augmented Reality Photo Booth [2]

The main advantage of this product is its compactness and easy installation, which, according to the manufacturer, should take about 5 minutes. The disadvantage could be considered a relatively small display, which is limited by the maximum size of manufactured tablets. This photo booth price is relatively high, in the version without a printer costs 7699 EUR and the one with a printer – 8449 EUR.

FB-003 Classic. It is a product of the Polish company Photo Booth Europe (Fig. 2). This device contains a 15″ touch screen from ELO and a mini-computer of various configurations (CPU i3/i5/i7, 120/240GB SSD, 4/8GB RAM) with OS Windows 10. The Canon 2000D camera is installed in the photo booth. The photo booth also includes a DNP DS-RX1HS printer. The product uses LED lights around the monitor to illuminate the subject. The price of this model starts at 4500 Euros [3].

Fig. 2. FB-003 Classic [3]

The main advantage of this product is printer included in standard equipment and the variability of the computer configuration. The significant disadvantage of this device is the weight, as the stand weighs 30kg and the packaging of components 27kg, which is in total 57kg. Another disadvantage is the large size of 65×47×172 cm.

Topfotobúdka FT1. It is a photo booth (Fig. 3) of Slovak origin, manufactured by ADAMASS s.r.o. Among all compared photo booths, this model has the largest 17″ display from IIYAMA. However, it also includes a more massive HP 260 W10 computer. It uses a Canon 250D digital camera and a HITI printer. It uses LED lighting around the display. The price of the photo booth is about 4700 Euros [4].

Fig. 3. Topfotobúdka FT1 [4]

The advantage over previous devices is that it contains the largest display, which will be appreciated by the photographed persons, especially if they will take pictures in larger groups. FT1 contains a printer at the start price. The disadvantage is the biggest dimensions of 60×45×170 cm and also the highest weight of all the presented solutions (approx. 80 kg).

Our solution – hardware. Our goal was to create a cheaper device that would be more compact and at the same time with a lower weight, while the function and operation of the photo booth would be comparable to commercial models. For this purpose, we chose as the control unit, the Raspberry Pi microcomputer (Fig. 4) with the Raspbian operating system [5]. Other components used were Nikon D4 camera, Asus VT 229H touchscreen LCD monitor, memory card, connecting cables, lighting, mouse and keyboard. The control software was created using the Python programming language.

The Raspberry Pi is a single-board low-cost microcomputer with a size 85×56 mm and approximately 20 mm thick, almost like a credit card. This small computer is an exposed motherboard on which hardware components are mounted, and its performance can be compared to a weaker desktop computer. It was designed primarily for teaching programming. Any operating system compatible with the ARM platform can be installed on it, but it must be taken into account that the RPi does not contain any hard disk or SSD disk. By connecting various external components, we can modify it for a specific environment and purpose [5].

After consideration of the financial costs, weight and dimensions, we chose the Raspberry Pi 2 Model B microcomputer (Fig. 4), which we had available for the implementation of the photo booth. The benefits of the newer version of RPi were not significant enough for our project to be invested in. We used the Raspbian operating system for the selected RPi [7]. This operating system is free. It is based on Linux, so it is also suitable for computers with lower performance.

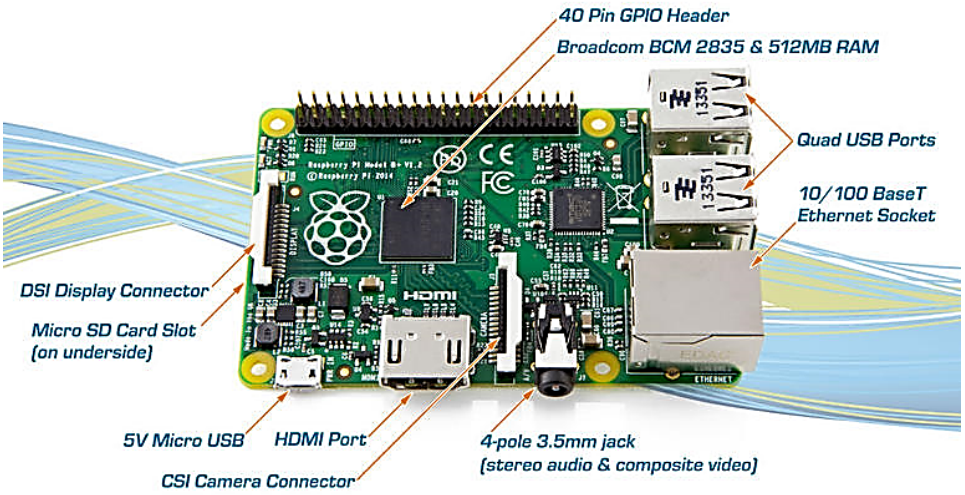


Fig. 4. Raspberry Pi 2 Model B [6]

We applied the Nikon D4 camera that we had available. If we had to buy a new camera, we would use, for example, a Canon 2000D camera, which can be bought with a lens for 400 Euros.

As a display device, we used a 21.5″ touch monitor Asus VT 229H, and its current price is 220 Euros. This monitor is intended to show a preview before shooting, inform about the status of the system and allow controlling the entire environment.

Other hardware components such as Micro-SD memory card, a mouse with keyboard and connecting cables were used.

The final set of the photo booth. In Fig. 5, we can see all the hardware components connected. The total cost of new components for the photo booth we have built (without the cabin) would be about 750 Euros. The estimated price of the photo booth cabin made of wood would be approximately 250 Euros. Its design is displayed in Fig. 6 – its dimensions are 60x60x23cm, estimated weight is about 13 kg.

Fig. 5. The final set of the photo booth

Our photo booth would cost several times less than commercially available photo booths. The great advantage of our device is also a larger display than the commercially available photo booths have, and at the same time, it is not heavy.

Fig. 6. Design of the case of the photo booth: front and back view

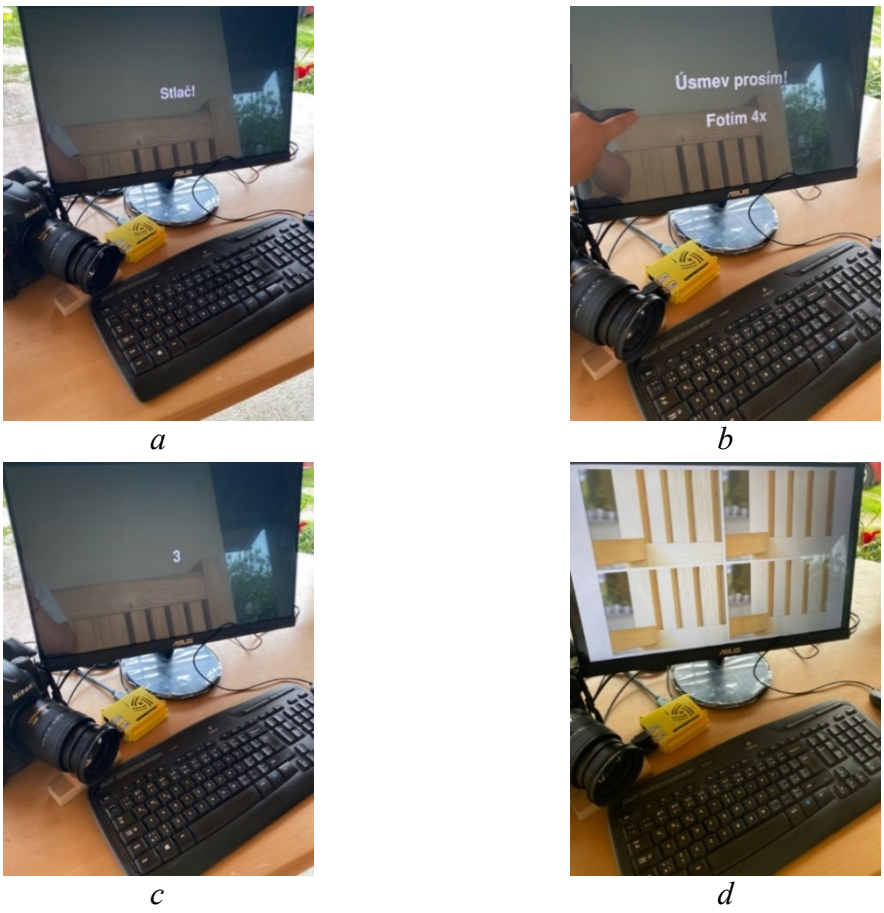
Our solution - software. The Python programming language was used to create a control program for our photo booth. It is a universal programming language that is used to create modern applications related to data analysis, media processing and other operations. This programming language works on various platforms such as Windows, Linux, Mac or even Raspbian. In our specific case, we used Python version 3.7.3 [8; 9; 10]. The resulting program has the task of providing communication between RPi, camera, monitor, mouse, keyboard, or printer, respectively implement photo sending to mail/internet storage. An important function is also communication with the user of the photo booth via the created GUI.

The resulting program contains several subroutines. They had to import and configure libraries as well as hardware. Communication between RPi and the used camera is realized in the subroutine camera.py (Fig. 7), in which the program gphoto2 is implemented [11]. At the same time, the camera.py subroutine must be able to solve situations in which the camera does not cooperate. After setting all parameters in individual subroutines, a graphical interface was created, which provides control and communication with the user. Subsequently, it was necessary to fine-tune the operation of the program for various error messages [12].

```
import subprocess
# Načítanie OpenCV
try:
import cv2 as cv
cv_enabled = True
except ImportError:
cv_enabled = False
# Oprava fotoaparatu
class CameraException(Exception):

def __init__(self, message, recoverable=False):
self.message = message
self.recoverable = recoverable

# Nacitanie pixelov z fotaku
class Camera_cv:
def __init__(self, picture_size):
if cv_enabled:
self.cap = cv.VideoCapture(0)
self.cap.set(3, picture_size[0])
self.cap.set(4, picture_size[1])
# Ulozenie fotky
def take_picture(self, filename="/tmp/picture.jpg"):
if cv_enabled:
r, frame = self.cap.read()
cv.imwrite(filename, frame)
return filename
else:
raise CameraException("OpenCV NEDOSTUPNE!")


class Camera_gPhoto:
"""gphoto2, ktoré bude fotoaparat využívať na fotenie"""

def __init__(self, picture_size):
self.picture_size = picture_size
# moznosti pripojenia fotaku
```

Fig. 7. Sample of the subprogram camera.py [12]

Testing functionality of the photo booth. After starting the program, the number of photos was set, for example, of four pieces. A preview of the captured object was displayed. When the shooting was activated, the program counted down and took a picture. This cycle was repeated four times with a 5 seconds pause between each shoot. As a result, four photographs were taken. They were compiled into a collage according to our prescribed rule, then displayed on the monitor and saved on the RPi disk (Fig. 8). Testing verified the full functionality of our solution.



a *b*

c *d*

Fig. 8. Practical test [12]

Conclusions. This article aimed to present the possibility of deploying the low-cost platform RPi in devices where standard computers are commonly used. We were able to prove compatibility between RPi with components such as camera and touch screen. The result is a fully functional photo booth, with a control program created in Python. With a little improvement, adding an external flash, printer, our photo booth could replace commercial photo booth. Compared to other commercially available devices of this type, we found that our solution has a much lower weight and also several times lower price [12].

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РЕАЛІЗАЦІЯ ФОТОКАБІНИ НА ПЛАТФОРМІ RASPBERRY PI

Актуальність теми дослідження. *У наш час використання недорогих одноплатних комп'ютерів, таких як Raspberry Pi, відбувається не лише в освітніх та хобі-проєктах, але також і у промисловості та комерційних продуктах. Саме тому надзвичайно важливо дослідити можливості використання таких недорогих систем.*

Постановка проблеми. *Метою дослідження був аналіз існуючих рішень та розробка дешевшої фотокабіни, яка за параметрами була б порівнянна або краща за комерційні рішення, але з набагато дешевше.*

Аналіз досліджень і публікацій. *При розробці нашого рішення та підготовці цієї статті ми врахували як поточні джерела - публікації та статті, що стосуються сучасного стану розвитку фотокабіни, так і існуючі рішення, доступні на ринку.*

Виділення недосліджених частин загальної проблеми. *Нині у створеному рішенні для фотокабін не здійснюється друк, а також автоматично не надсилаються отримані фотографії на електронну пошту чи в хмару. Це буде впроваджено на наступному етапі розробки.*

Постановка завдання. *Мета цієї статті – пояснити, як ми можемо розробити оригінальну фотокабіну за допомогою платформи Raspberry Pi.*

Виклад основного матеріалу. *Для вирішення поставленої задачі ми використовували недорогий одноплатний мікрокомп'ютер Raspberry Pi, та для розробки фотокабіни поєднали його з фотокамерою. Для керування було розроблено програму в середовищі Python, яка є однією з найпоширеніших мов програмування і знаходить застосування в різних сферах.*

Висновки відповідно до статті. *Використовуючи Raspberry Pi та фотокамеру, було розроблено повнофункціональну фотокабіну, яку порівняно з комерційними продуктами, і яка має значно нижчу вартість.*

Ключові слова*: Raspberry Pi (RPi); Python; фотокабіна.*

Рис.: 8. Бібл.: 12.

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